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# DISCOVERY

A Monthly Popular Journal of Knowledge

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## CLASSIFIED ANNOUNCEMENTS

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(*Continued on page* lxxxv)

# DISCOVERY

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## Notes of the Month

Once again the British Association has chosen for its meeting-place a great English manufacturing centre. The last town of this nature to be selected was Leicester, the seat of the 1933 meeting, at which, as at this year's Nottingham meeting, the hospitality of a constituent College of the East Midlands University was enjoyed. The happy combination of up-to-date learning and efficient commercial enterprise provided by such centres is specially apt for the entertainment of such a society as the British Association; and more than ever in these days when the application of science to the public weal is occupying an increasing amount of the Association's energies. "To obtain more general attention for the objects of science, and the removal of any disadvantages of a public kind which impede its progress"—this phrase from the first Statute adopted on the foundation of the Association is ever in the mind of the Council, together with the need for a more systematic presentation of selected subjects of scientific interest in their bearing on the life of the community.

* * * *

The suitability of a centre like Nottingham for such a presentation is obvious, and the Council has shown in its choice the forethought that we have come to expect of them. The President's address dealing with the development of evolutionary thought as recorded in the meetings of the Association has a historical bias well suited to a meeting in a city which already has two successful assemblies of the Association to its credit. Nottingham has given hospitality to science in this way in 1866 and in 1893, the Presidents having been respectively William R. Grove Q.C., F.R.S., and Professor J. S. Burdon Sanderson, F.R.S. A certain amount of leeway in the matter of the number of members should be made up, as for the 1893 meeting the number fell below 2,000. It is to be noted, however, that the Association did not assemble on that occasion until September 13th, and a glance through the annual figures reveals that a date as late as this is not conducive to a high membership. With the late summer of 1937 promising to be a glorious one, the advance of a fortnight in the date of the meeting should prove a great attraction, especially in view of the delightful country easily accessible from Nottingham in almost every direction.

* * * *

The National Trust proceeds from strength to strength; and an apparent check on its advance only results in a more strenuous reaction. In the current Annual Report it appeared that the appeal for preserving the southern range of the Malvern Hills was not meeting the rapid response which it might have been expected to elicit; and something more than £1,000 remained to be raised before October 31st this year. An anonymous benefactor has now come forward with a scheme to save the situation; he has promised to double all contributions raised on condition that the total required to close the fund, inclusive of his own contribution, is received by the time specified. In the knowledge that any contribution they send will thus be automatically doubled in value, lovers of the English countryside should not hesitate to send their subscriptions to the Secretary of the National Trust, 7, Buckingham Palace Gardens, London, S.W.1. Members of the British Association may be reminded that, in addition to numerous properties in the Derbyshire moors and dales, ranging from Duffield Castle to Mow Cop, the National Trust owns Colston Bassett Cross, only ten miles south-east of

Nottingham, and Tattershall Castle, a fine example of 13th-century brickwork, in Lincolnshire, within easy motoring distance of Nottingham.

* * * *

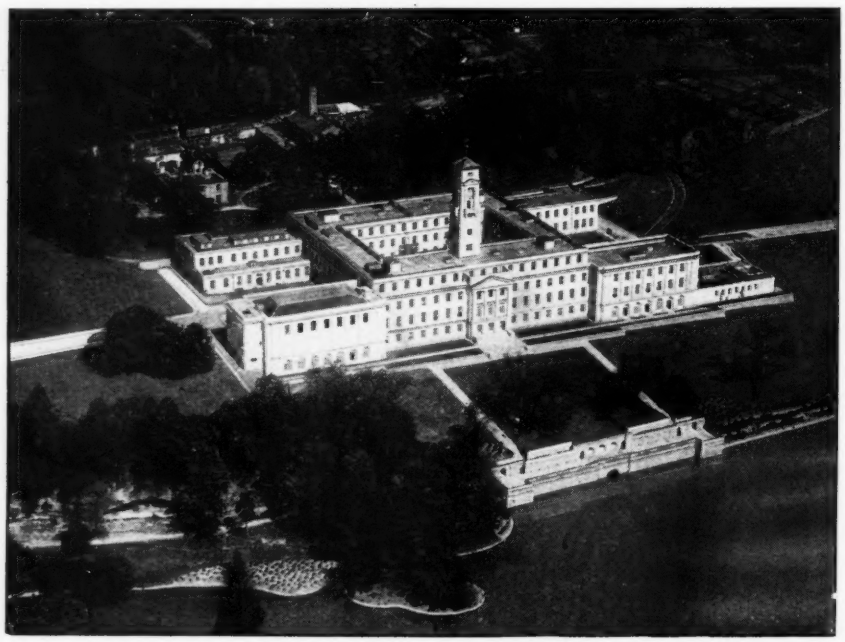
A more widespread knowledge of elementary entomology would have obviated a recent "scare" in which a market-gardener in Essex mistook a queen ant for a Colorado beetle! The ant, in search of peace and quiet, had taken refuge in a hole in a potato; her emergence was the signal for a frenzied appeal to the Ministry of Agriculture and a useless visit from one of its officials.

* * * *

THE appearance of the twenty-five volumes of the *Modern Knowledge Library* (Benn, 3*s*. 6*d*. each, 84*s*. the set complete) marks a new departure in the realm of educational publishing in the fullest sense. Sir Ernest Benn has often been called a public benefactor for creating his famous *Sixpenny Library*, and the only criticism to be levelled against these admirable pamphlets was that they were, perhaps, *too* compendious—sometimes a valued number in the series would be swept away and lost before its reader had perused it. The *Modern Knowledge Library* does away with even this criticism. Each volume, while still remaining handy enough for the pocket, contains the material of six of the original "Sixpennies," neatly bound into book form. The subjects have been systematically arranged: Art occupies two volumes, History seven, Economics and Sociology three, and so on; while no less than eight of these authoritative volumes are devoted to Science. The word authoritative is used advisedly: a glance at the list of authors justifies it at once. A selection would be invidious, but a random scanning of the list reveals many names familiar to the British Association.

* * * *

According to a Canadian Press telegram a number of distinguished scientists from the United States and Great Britain are engaged in the Canadian Arctic this summer in investigatory work. The Royal Geographical Society of Great Britain is sending David Haig-Thomas, John Wright, Richard A. Hamilton and is co-operating with St. John's College, Cambridge, in sending J. M. Wordie. Arthur C. Turney and J. Kennemseutt represent Carnegie Museum, Pittsburgh, and Commander D. B. MacMillan is leading the Bowdoin-MacMillan Artic Expedition. A number of other American institutions are also despatching various eminent explorers to represent them, and the Canadian Government is also sending an unusually large number of surveyors and other classes of scientists into the north, most of whom set sail on the *Nascopie* from Montreal. The East Arctic Patrol, as this expedition is called, will be commanded by Major D. L. McKeand. "No person shall enter the North-West Territories for scientific or exploration purposes without first obtaining licence so to do from the Commissioner of the said Territories," reads the Ordinance passed by the North-west Territories Council. When the licensee returns he has to submit to the Council "a statement setting forth any scientific information, if any, which he shall have secured," also a report of the places visited and a list of specimens taken. He must also furnish the Mounted Police or officers of a Canadian Government patrol vessel with a log of the voyage and full information of any trip taken by land.



*University College, Nottingham, in its attractive park, affords an ideally convenient meeting-place for the various sections of the British Association.*

# The Nottingham Meeting of the British Association

*In its annual British Association number* DISCOVERY *is again privileged to publish a special message from the President, who is confident that the meeting at Nottingham will maintain the high standard of interest of former occasions. The list of general and sectional meetings which follow will, it is hoped, be of use both to those who are fortunate enough to attend at Nottingham and to those who will follow the meeting in the Press.*

## President's Message

*Sir Edward B. Poulton.*

It is interesting to compare the meeting-place of the British Association last year with that in which we are to assemble on September 1st; interesting and characteristic of a healthy desire to enter into the most varied manifestations of active national life. It is not necessary to write of the ancient historic associations of Nottingham which will add so greatly to the interest of our visit. A brief but excellent account of the city appears in the Preliminary Programme which also notes that "every member attending the Nottingham Meeting will be presented by the City Council with a copy of the Official Guide to the City," and that "The Scientific Survey of Nottingham and District" will be issued with the Programme of the Meeting which is already in the hands of those who have intimated their intention to be present.

The first meeting of the British Association at Nottingham was held in 1866 when William R. Grove, Q.C., F.R.S., was President, the second in 1893 under the presidency of Sir J. S. Burdon Sanderson, F.R.S. It is especially interesting to remember that Canon Tristram was president of Section D at this second meeting and that, in his address, he gave an account of his observations on the birds of the Algerian Sahara, visited in 1857 and 1858, and of how he returned in time to read the Darwin—Wallace Essay (of July 1, 1858) on Natural Selection, to accept a theory which so completely explained what he had seen and to publish his belief before the appearance of the *Origin of Species* on November 24, 1859.

With the immense growth of science since the last meeting in Nottingham, the number of the sections has been increased, and an abundant supply of addresses, papers and discussions will provide a broad field for the most varied interests. Following the excellent system recently introduced, communications of immediate public interest in relation to the life of the community are specially marked in the Programme. The sections will enjoy exceptionally favourable opportunities of discussion and contact of every kind, all being accommodated in the University College and the immediate vicinity.

We may look forward with confidence to a most successful third meeting of the Association at Nottingham.

EDWARD B. POULTON.

## General and Sectional Meetings

The Inaugural General Meeting will take place in the Albert Hall, Circus Street, off Derby Road, at 8.30 p.m. on Wednesday evening, September 1st, when Professor Sir EDWARD POULTON, D.Sc., LL.D., F.R.S., will deliver the Presidential Address, dealing with the History of Evolutionary Thought as recorded in the meetings of the British Association. Subject to subsequent announcement, admission will be by membership ticket; seats will not be numbered, and there will be no individual reservation of seats in advance. The first Evening Discourse will be given on Friday, September 3rd, by Dr. R. E. SLADE, on Grass and the National Food Supply. The second Evening Discourse will be delivered on Monday, September 6th, by Professor J. GRAY, F.R.S., and will deal with the Mentality of Fishes.

A public lecture will be given in Nottingham by Professor H. HARTRIDGE, F.R.S., on Illusions of Colour, and a series of lectures is being arranged in various towns neighbouring to Nottingham. The lectures will be organised by local authorities of the towns concerned.

The Right Worshipful the Lord Mayor of Nottingham (Councillor E. PURSER, J.P.), the Lady Mayoress, and members of the City Council will hold a Civic Reception at the Nottingham Castle Museum on Thursday evening, September 2nd, and on Tuesday afternoon, September 7th, there will be a Garden Party in the grounds of University College.

The Nottingham meeting, the third held in this great Midland centre—the Association has met there previously in 1866 and 1893—will present many contrasts to last year's Blackpool Meeting. Whereas last year the Sections were accommodated singly or in small groups in various educational buildings, this year they will be housed practically under one roof, in the buildings of University College, Nottingham. This fine modern group of collegiate buildings stands in University Park, about three miles from the centre of the city, and for the convenience of those members who have secured living accommodation in the city itself, some of the functions of the Reception Room will be duplicated at the Old College, Shakespeare Street.

### Visits to Works

Besides being the seat of a University College, Nottingham is important as a centre of many and varied industries, and the choice of "visits to works" available to members of the Association is especially interesting this year. Nottingham is the home of such great industrial concerns as the works of Messrs. John Player & Sons (branch of the Imperial Tobacco Company), the wonderful and modern works of Messrs. Boots, Cash Chemists, the Raleigh Cycle Company and numerous extensive factories employed in the production of hosiery, lace and numerous other branches of the textile industry. Over and above these more strictly local industries, visits will be paid to many other important industrial centres of the Midlands, notably Derby, with the Rolls-Royce and the International Combustion Co.'s works and the research station of the L.M.S. Railway; and Loughborough, with Taylor's Bell Foundry.

Nottingham itself retains much that recalls its proud and ancient history. Among churches, St. Mary's, High Pavement; St. Nicholas', a fine example of the period of Charles II; St. Peter's, and Lenton Church with its Norman font and the excavations of Lenton Priory are notable. In Castle Gate are many beautiful houses of the 18th century, and Newdigate House (1672). Two ancient inns are the Trip to Jerusalem, reputed to be nearly eight centuries old, with curious underground rooms and cellars, and the Salutation, of the 15th century. Weekday Cross is the pre-Conquest market-place of Nottingham; High Pavement and Low Pavement have buildings of historical interest, and Church Cemetery shows curious caves. The Castle, though entirely rebuilt, contains interesting art and archæological collections; and Wollaton Hall, a short distance from the city, is a fine Elizabethan mansion now containing a natural history museum; and Newstead Abbey, ten miles off, is another mansion of great architectural interest, with additional literary associations as the home of Lord Byron.

The surrounding country is full of charm and interest: within easy reach are the Derbyshire Dales, with their remarkable geological features; the "Dukeries," with their princely mansions and estates amid the sylvan surroundings of Sherwood Forest with its romantic tradition; the unique survival of the open-field system and Laxton and Eakring; and the magnificent cathedrals of Lincoln and Southwell.

### Sectional Presidents

The President of Section A (Mathematical and Physical Sciences) is Dr. G. W. C. KAYE, O.B.E., Superintendent of the Physics Department of the National Physical Laboratory, who will speak on "Noise and the Nation" in his presidential address.

Section B (Chemistry) has as its President Dr. F. L. PYMAN, F.R.S., Research Director of Boots Pure Drug Company. He has held a professorial chair in the Manchester College of Technology and has been director of the Wellcome Chemical Research Laboratories. He will speak on "Recent Research in Chemotherapy."

Professor L. J. WILLS, who occupies the Chair of Geology and Geomorphology at Birmingham University, is President of Section C (Geology). His address will deal appropriately with "The Pleistocene History of the West Midlands."

In Section D (Zoology) the Presidential Address, on "The Sex-Ratio," will be delivered by Professor F. A. E. CREW, Professor of Animal Genetics in the University of Edinburgh. Professor Crew has written many papers and text-books on genetics and various aspects of sex-determination.

The Presidential Address in Section E (Geography) is on "The Changing Distribution of Population." Professor C. B. FAWCETT, the Sectional President, who has held the Chair of Economic and Regional Geography in the University of London since 1928, has contributed many articles to the periodical geographical press, and is the author of a standard Political Geography of the British Empire.

"Economic Research and Industrial Policy" is the subject chosen by Professor P. SARGANT FLORENCE for his address to Section F (Economic Science and

Statistics). Professor Sargant Florence, who has had much experience of industrial research in the United States, now occupies the Chair of Commerce at the University of Birmingham, and has contributed extensively to the literature of industrial theory.

In Section G (Engineering) the President is Sir ALEXANDER GIBB, G.B.E., C.B., F.R.S., senior member of the distinguished firm of consulting engineers that bears his name. He will speak with authority on "Research in Engineering." Sir Alexander's engineering activities have taken him all over the world, and his recent *Life of Telford* is a classic in the history of engineering.

Section H (Anthropology) is presided over by Dr. J. H. HUTTON, C.I.E., Lecturer in Archæology and Anthropology at Cambridge, who will speak on "Assam Origins in Relation to Oceania." Dr. Hutton is an authority on the Naga tribes of Upper Assam.

Dr. E. P. POULTON, son of this year's President of the Association, is President of Section I (Physiology), and is Physician to Guy's Hospital. He will enunciate some new views on "Metabolism, Nutrition, and Growth in Man."

In Section J (Psychology) the Presidential Address will deal with "Tests in Common Use for the Diagnosis of Colour Defect." Dr. MARY COLLINS maintains the position of women in the list of Sectional Presidents. Dr. Collins is Lecturer in Psychology at the University of Edinburgh and Consulting Psychologist at the Psychological Clinic of that University.

Section K (Botany) will be addressed by its President, Professor E. J. SALISBURY, F.R.S., on "The Modern Study of Plants in Relation to Education." Professor Salisbury holds the Quain Chair of Botany at the University of London; he is an authority on ecology, and has contributed recently to DISCOVERY.

Mr. H. G. WELLS, President of Section L (Education) is too well known to require biographical notice here; his appointment is a fitting recognition of his services to the cause of Science in general. He will speak on "The Informative Content of Education."

The subject of the Presidential Address in Section M (Agriculture) is "State Intervention in Agriculture," an important problem of the day. The President, Mr. J. M. CAIE, is an Assistant Secretary in the Department of Agriculture for Scotland and is, therefore, fully qualified to deal with the problem from both the government's and the farmer's point of view.

## Maiden Castle, 1937

The season of archæological excavation in Great Britain is now in full swing. By the end of July operations had been resumed on several of the more important sites where investigations had begun previously. Dr. R. E. Mortimer Wheeler and Col. C. Drew, with a number of archæological students, were already at work at Maiden Castle, Dorchester. The excavation of this site, by far the most important which has been investigated systematically in this country, is now approaching its final stages. Three areas are being attacked. At the eastern entrance the newly discovered earlier fortifications beneath the earthworks screening the gateway include two outer gateways, and afford, with the previously known inner gateway, a complex plan hitherto unparalleled in prehistoric fortification; while the area outside includes both the ground on which iron ore was smelted, and a cemetery which should afford further information on the physical characters of the inhabitants. Within the fort investigations are being directed to the neolithic trenches found last year near the Temple, which may have been part of the defensive system of the neolithic occupation of 2000 B.C.; and, lastly, the original west entrance, found last year but not then explored, is being examined.

## Fastest Train in British Empire

*Photo*] [*L. T. Catchpole*

*The L.N.E.R. "Coronation" streamlined train, which now runs between London and Edinburgh, with one stop, in six hours. The distance is 392¾ miles, and this is the fastest service in the Empire. This picture shows the train travelling at 82 m.p.h near Hatfield. The last coach now has a streamlined "beaver" tail, and is an observation car. A feature of the train is that cooking in the restaurant car is done by electricity from axle-driven generators.*

# Natural History Exploration in Arabia

**By David A. Bannerman, M.B.E., Sc.D.**

*The opening-up to science of the most desolate parts of Arabia has been a major task of 20th-century exploration. Public interest has been concentrated mainly on the geographical information acquired, but here Dr. Bannerman shows that the zoological knowledge gained is of no less importance and interest, especially in the realm of birds.*

TWENTY or even ten years ago, if any geographer had been asked to name one of the least explored portions of the earth he would unhesitatingly have replied "Arabia," and if this was true of the geographer it was doubly true from the point of view of the naturalist. Thanks mainly to a select few who may be termed both explorers and naturalists, this state of affairs is fast changing and Arabia is yielding, to a small energetic band, the secrets which it has held for countless years. Not only has that vast desert known as the Rub' al-Khali been crossed from north to south and from east to west, but the Englishmen who have accomplished this feat have done much more than undertake a hazardous journey, for they have enriched in many directions our knowledge of the zoology of the country through which they passed.

Mr. Bertram Thomas—the first European successfully to cross the Rub' al-Khali (though he only anticipated Mr. St. John Philby in this feat by a few months)—brought back with him to the British Museum an interesting zoological collection which the writer helped to unpack. Unfortunately Thomas was unable to collect any birds, for on such a journey he very naturally could not take with him a skinner. For the same reason Philby had but little opportunity to make ornithological collections on his early epoch-making journeys, even had time allowed; but with easier conditions and by dint of the influence he can bring to bear, he has since been able to add more to our knowledge of the birds of Arabia and to the collections of the British Museum than anyone would have dreamed to be possible, even five years ago. So long ago as 1920 Philby had been awarded the Founder's Medal of the Royal Geographical Society for his exploration work in Arabia.

Before recounting the success that has attended Philby's excursions into the realms of ornithology, mention must be made of some who went before him—merely, however, scratching the surface as it were. The first bird collections of any importance were made in Arabia by two young Germans, Hemprich and Ehrenberg, in 1825, the former sacrificing his life for his science. They were followed by another of their countrymen prior to 1829—one Rüppell, who visited certain towns along the Red Sea coast, including Jidda. But it is mostly to Englishmen that we are indebted for our knowledge from that time onwards. As might be expected, the Aden Protectorate received most attention and collections were formed by Colonel J. W. Yerbury (1886), Lieutenant Barnes, Richard Hawker, Blaney Percival (afterwards Game Warden in Kenya), W. Dodson, and G. Wyman Bury.

In Northern Arabia Douglas Carruthers made a short but highly successful expedition in 1909 in search of the Arabian Oryx, which he finally secured at Taima. The exciting details of this adventurous trip have only recently been made known in a charming book entitled *Arabian Adventure*. Birds occupied but a secondary place on this expedition, but the discovery of the true haunts of the Arabian Oryx and the preservation of good specimens was no mean feat to have accomplished, undertaken as it was entirely alone and on his own initiative. It is a pity that the full account has only just been made public.

[*Photograph by H. St. J. Philby.*

*View in the Arabian highlands, the habitat of the new Black-Throated Chukor.*

Four years after this adventure (in 1913), the British Museum obtained the services of G. W. Bury to visit Yemen, the former Turkish province in south-western Arabia. The expedition was entirely successful and Bury sent home a collection of 400 birds representing 100 species, adding no less than 35 names

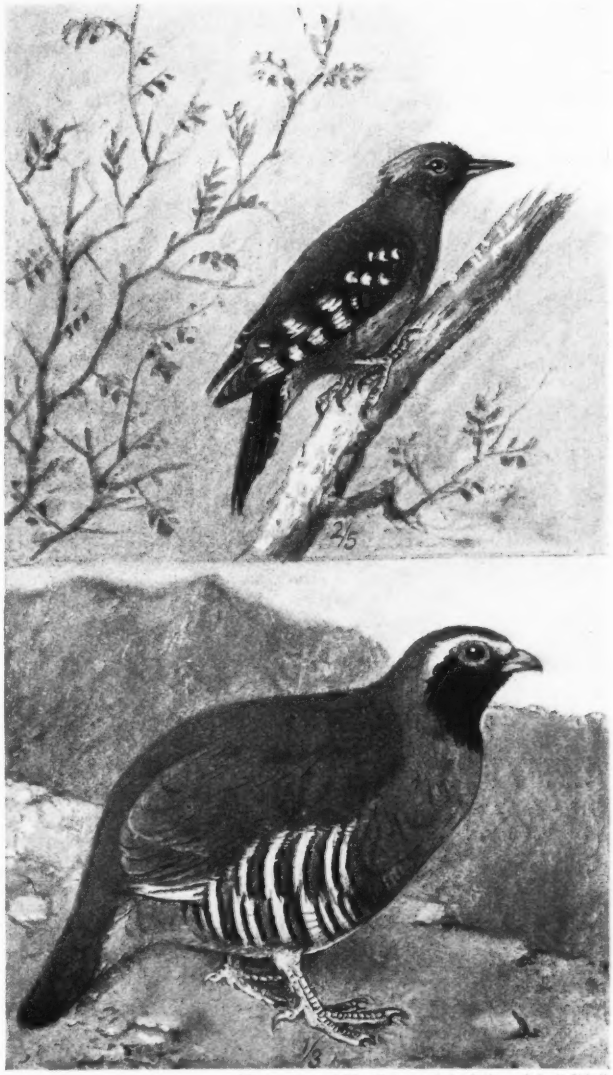
to the list of birds then known from Southern Arabia. Among these last, eight birds were found to be new: a grosbeak, a seed-eater, the Yemen finch, "which looks like a sparrow and sings like a skylark," and for which a new genus had to be created, a thrush, an accentor, a chat, and a fly-catcher, which was named *Parisoma buryi* in honour of the collector.

Considering that this collection was made within a comparatively small area, it pointed to the possibility of great discoveries taking place in the bird world when Arabia could be explored with less risk. Bury was well aware of the prizes that lay in store for a naturalist should conditions improve sufficiently for an expedition to enter the forbidden land, but he had small hope of carrying this out himself. Indeed he knew the difficulties only too well, and wrote at the time in his diary: "Both sides" (*i.e.* Turk and Arab) "are suspicious of aliens and of each other, while my pursuits required a freedom of movement which was a constant source of anxiety to a Government that had to practise a conciliatory tribal policy."

Bury soon saw that there was no chance of extending his expedition southwards along the inland plateau, and he had long known that east and north were alike out of the question. The dual control then exercised in Yemen made it practically impossible for a naturalist "with his impedimenta to betray him" to work in the country, and Bury showed a prophetic vision when he observed towards the close of his expedition, "The present political situation convinces me that it will be long before another naturalist is allowed to work afield in the interior, and the coastal districts are now closed."

Once more the veil of mystery descended over Arabia—extending even to the coastal districts—and it was not lifted until the turmoil of the Great War had ceased and comparative peace had come once again to the land. It so happened that there was an ornithologist in Arabia even during the *Revolt in the Desert*—to wit, Colonel Richard Meinertzhagen, described somewnat incorrectly in a masterly pen picture by Lawrence in *The Seven Pillars of Wisdom* as "a student of migrating birds drifted into soldiering." But here even Meinertzhagen could not quite live up to the reputation he had gained in Palestine, when serving as Allenby's Chief Intelligence Officer, the tale being told that the N.C.O.s on his staff were chosen for their ability in skinning birds! True, when the War was over, Meinertzhagen returned with redoubled zest to his ornithological pursuits, and his work in the Aden Protectorate bore fruit in 1924 when he published an account in the *Ibis* of the birds which inhabit that British outpost. Work in this corner of Arabia was carried on by Colonel Boscawen, who made various journeys in the Yemen and Hadhramaut in quest of birds from 1932 onwards.

All the foregoing, however, records only the gradual lifting of the veil from the coastal provinces: the Great

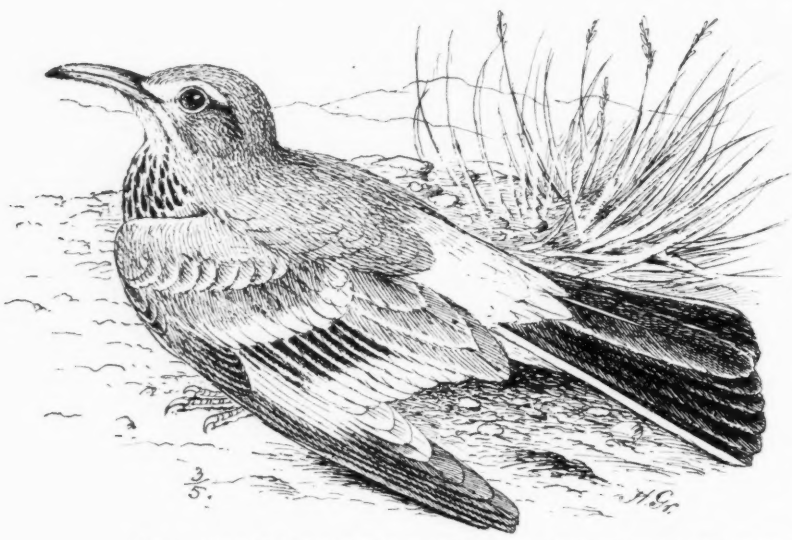


[By courtesy of Mr. Bates and the Editor of the "Ibis."

*Above: the Arabian Woodpecker* (Desertipicus doræ), *one of the new birds discovered by Mr. Philby. It is the only woodpecker ever to have been found in Arabia, and a new Genus was created for it. Below: the Arabian Rock-Partridge* (Alectoris græca philbyi). *Mr. Philby's most sensational discovery was this fine Chukor found in the mountains of the Mecca district.*

South Desert still remained untrodden by any European, and even the fringe had not been penetrated. It fell to Sir Percy Cox, our first High Commissioner for Iraq, himself a fine naturalist with good ornithological work at Muscat to his credit, to pave the way for the first important journey into the unknown, undertaken by Major R. E. Cheesman, at that time his private secretary. Cox, whose name is one to conjure with in Saudi Arabia, was ever ready to further ornithological discovery, and thanks to his unparalleled influence, Cheesman finally obtained permission to penetrate as far as the Oasis of Jabrin, whose palm groves were at that time (in Cheesman's own words) " surrounded by a veil of mystery, and many were the tales of wonder and magic told by the superstitious badawin who graze their camels in the vicinity."

Starting from 'Oqair on the Gulf of Bahrain, his route took him by way of Hufuf, where an enforced stay enabled him to make some interesting zoological discoveries. His final goal, Jabrin, lay in Eastern Nejd in the northern portion of the Great South Desert, and had never before been visited by a European, much less by one whose knowledge of birds enabled him, under trying conditions, to make a fine collection with such discrimination that several new forms were discovered—new races of the common sparrow, desert lark, and streaked wren-warbler being procured.



[*From " The Birds of Tropical West Africa " by permission of the Crown Agents for the Colonies.*

*The Bifasciated Lark* (Alaemon alaudipes alaudipes) *; found by Mr. Philby to inhabit the heart of the Rub' al-Khali. Bird life in the great South Desert is represented by a few species only.*

As was to be expected, most of the smaller birds encountered by Cheesman were racial examples of pale desert forms whose plumage resembled the desert ground or the white sandstone which weathers pinkish. It then matches closely the plumage of the " Fayum " or desert eagle-owl and the new desert lark discovered near Salwa, both of which were living in the sandstone hills or the débris at their foot. The eagle-owl is a magnificent bird which ranges from Arabia and the Syrian desert to Damergu and the Aïr Massif in the Southern Sahara where Captain Angus Buchanan found it on his first crossing of the Sahara by camel. The same bird has recently been found by G. L. Bates at Timbuktu. Its wonderful golden-yellow eyes must be seen to be believed, and the pale yellowish-buff plumage, marbled and blotched with white and various tones of brown, blends so marvellously with the ground it inhabits that Cheesman only became aware of its presence by searching the hillside with field glasses and so located a pair " asleep but watchful with ear-tufts erect, at the mouth of some cave." The illustration of this owl is reproduced from Whitaker's " Birds of Tunisia " and is one which the author kindly allowed the present writer to use in his own book on West African birds. It gives a very good idea of this bird (see page 265).

The zoological affinity of Jabrin in Arabia with Aïr in the Southern Sahara is not confined to the eagle-owl, for a new Jerboa discovered in the former locality proved to have its nearest relative in these mountains of the Sahara desert.

The extraordinary little rat-like desert rodents known as jirds were represented in Cheesman's collection by no less than four very distinct forms, all new, two being species and two subspecies. These animals have a most interesting habit : " They are shy," writes Cheesman, " and any movement causes a stampede. They then sit inside the holes, and as long as there is a suspicion of danger they make a warning note resembling a ticking sound, as if a man were marking the seconds by knocking two sticks together. While the noise continues no Jird will show itself." Another discovery was of a species of which two distinct races were caught at Hufuf, each living an apparently isolated existence

from the other, "separated by a mile of chalky sandstone plain which seems to constitute an impassable barrier." These two jirds, races of *Meriones syrius*, are well recognisable subspecies, the one living in the gardens watered by the Khadud spring being redder in colour, as well as stronger and bigger, than its neighbour living "across the barrier," watered by the Khorasan spring. Both were hitherto unknown and have been named in honour of the explorer's two sisters *edithæ* and *evelynæ* respectively. Jirds are very pugnacious little creatures and we are told that contests are frequent in which biting each others' long tails plays a conspicuous part; so whether Major Cheesman's sisters appreciated the compliment thus paid them may seem a little doubtful! In Arabia these animals apparently play much the same havoc with crops as do rabbits in our own country.

Of Cheesman's botanical collections the majority, as might be expected, were representatives of characteristically desert plants, but one very curious fern merits special mention. Its normal habitat is in still or slow-running water and it is of particular interest in that it grows totally submerged. Its distribution is pan-tropical, extending also into the sub-tropics. Its discovery at Hufuf was not particularly remarkable but the actual site most certainly was, for it was found flourishing and multiplying vigorously in *hot* springs where the temperature stands permanently at just under 90° F. This fern was *Ceratopteris thalictroides*, the only other fern found being the almost cosmopolitan maidenhair. In an even hotter spring in Hufuf Oasis, in which the thermometer registered 101° Fahr., Cheesman found the hot spring fish (*Cyprinodon dispar*), a remarkable fish, but already known to scientists. The largest male measured 79 mm. from the end of the tail to the tip of the lower jaw, and 22 mm. in depth from belly to back. This little fish may be looked for in many hot springs. It is said to occur in those at Hammam Meskoutine in Algeria where once the writer, unaware of the fact at that time, filled a hot-water bottle with water so hot that it might have been poured from a boiling kettle, and which was still warm in the morning! Cheesman tells us that if a bather sits in the water at Hufuf, shoals of these little fish approach and nibble his legs—a fact which Cheesman did not believe until he saw it with his own eyes. He refrains from saying whether he experienced this curious sensation on his own person, but I suspect *not*.

[*From "The Birds of Tropical West Africa" by permission of the Crown Agents for the Colonies.*

*The Cream-Coloured Courser* (Cursorius cursor cursor). *One of the few bird-inhabitants of the Rub' al-Khali.*

If I have devoted too much space to Cheesman's explorations I may be excused on the plea that his was the first journey really to fire my imagination, knowing as I do the explorer and the splendid work that he has accomplished of recent years in Abyssinia, where he served as H.M. Consul for North West Ethiopia from 1925 until almost the outbreak of the Italo-Ethiopian conflict.

We now come to the spectacular journeys of Bertram Thomas and St. John Philby, both of whom thrilled the world by their daring ventures. Philby knew that Thomas had planned to cross the Rub' al-Khali and tells in his book, *The Empty Quarter*, of his disappointment at the enforced delays in his own plans that enabled his rival to win the race. He even wondered if Cheesman and Thomas had left him anything to do "when his own turn came in due course"! One has but to read the account of his journey or to hear him describe some of

his experiences to realise how much he did accomplish and how groundless were his qualms. Both journeys are now matters of history but the glory of their achievement remains, and we may take pride in the fact that both were made by Englishmen.

For reasons already mentioned in this article, Bertram Thomas collected no birds. His "dash," as we may term it, was accomplished in record time and his collecting activities had perforce to suffer somewhat in consequence. His Arabian achievements are for the time being unfortunately at an end.

### Across the Empty Quarter

Starting from Salala, in Dhufar, on the coast of the Arabian Sea, on 10th December, 1930, Thomas crossed the Rub' al-Khali from south to north, arriving at Doha, in Qatar on the Persian Gulf, on 5th February, 1931, having made the journey on camel in fifty-seven days—a distance of 650 miles. The notes on the natural history specimens collected on this journey, written by specialists in the British Museum, have already been published in *Arabia Felix*. Owing to the exceptional conditions under which the crossing of the Rub' al-Khali was accomplished, the birds were represented by only two eggs—those of a large bird of prey believed to be the Abyssinian tawny eagle. Thomas's contributions to science on this journey were made in other directions, collections of reptiles, amphibians, butterflies, moths, insects, rocks and minerals having occupied what attention he could give to them. Of special interest was a meteorite picked up on the sand at Buwah, one of the only three ever discovered in Arabia. We ornithologists may hope that Thomas will one day return to that happy hunting ground, the mountains of the Dhufar littoral, with the express purpose of filling the one blank in his collections—that of ornithology, with which subject the writer of this article is particularly concerned.

It has fallen to St. John Philby, an explorer of a different type—one who is resident in the country and whose knowledge of Arabia as it is to-day is surely without a rival—to open a field of zoological exploration which has already had astonishing results. Philby's opportunities are unique and if judged by what he has already accomplished in ornithology alone, no man could have made better use of them. Robbed by Bertram Thomas of the achievement of being the first European to cross the Rub' al-Khali, Philby's crossing of the Great South Desert was no less spectacular. He chose a different and much longer route from Thomas's. Setting out from the north (whereas Thomas travelled in the opposite direction and by a much more direct route), Philby's great journey began at Hufuf, in Hasa on the Gulf of Bahrain, thence by way of Jabrin Oasis (the furthest point reached by Cheesman) to Maquainama and Al-Hadida, and so to Naifa, just south of latitude 20° N., whence the crossing of the Rub' al-Khali began in earnest from east to west. Starting on the final lap from Naifa, after almost insuperable difficulties that would have defeated a less determined man, the crossing of the Great South Desert to Sulayil was accomplished. The latter objective was reached on March 14th, 1932, and so to Mecca on the ninetieth day after setting out from Hufuf—truly a superhuman achievement!

Zoological, mineral, and botanical collections were made throughout the journey, and fourteen different species of birds were obtained, including the *bifasciated lark* which was one of the few species to inhabit the interior of the Rub' al-Khali. This lark is a widely ranging species well known to the writer in northern Africa. Its melodious piping notes are one of the joys of the desert. On the ground it is not easy to see but once it moves it runs with incredible rapidity. One of the prettiest sights I have ever seen was of a male bird courting the female, rising in the air above her and giving forth his delightful song. A picture of it is reproduced here from my book on West African birds. The desert warbler (*Sylvia nana*) and Macqueen's bustard (*Chlamydotis undulata macqueenii*) were two other birds of the Great South desert which were seen at frequent intervals, and on one occasion a cream-coloured courser, of which I reproduce another drawing from my book through the courtesy of the Crown Agents for the Colonies.

### An Amazing Discovery

Space will not permit of more than a passing reference to the birds observed on this journey of Philby's, but one discovery of surpassing interest was made. At various points on his journey Philby collected fragments of ostrich eggs in the Rub' al-Khali. Those collected at the beginning and towards the end of the crossing were definitely recent shell fragments, having the appearance of the eggs of the Syrian ostrich (*Struthio syriacus*); those from the middle of this desert waste were equally definitely more mineralised. It seems, according to Dr. Percy Lowe who examined these fragments, that both "types" belonged at one time to the same species of ostrich (*syriacus*) which Philby learned had not been seen in this part of Arabia for forty or fifty years. There was nothing very surprising in the discovery of these shell fragments in the Rub' al-Khali, but an amazing discovery had already been made even before Naifa was passed. Philby had reached a point in his journey about latitude 22° S.—Shuqqat al-Khalfat, to be precise—when he found in an old river bed a shell fragment which Dr. Lowe has identified with *Psammornis*—a

giant struthious bird—the egg fragment having belonged to a bird which very greatly exceeded in size the common Syrian ostrich. This was a great discovery and has suggested, as Lowe points out, that there was a much more extensive land connection between Arabia and Northern Africa than now exists, during the period of time in which the genus *Psammornis* flourished. An egg shell approaching this specimen in thickness (3.2 mm.) had been discovered in Algeria by Lord Rothschild and Dr. Hartert some years earlier and had been named *Psammornis rothschildi*. The fragment obtained by Philby is 2 mm. less thick, and the possibility of the same species of giant ostrich having laid both eggs can but be problematical.

Philby's ornithological discoveries on the journey referred to did but whet his appetite for more, and on his return to civilisation he turned his attention to the possibilities which the further ornithological exploration in Arabia had to offer. A visit to the British Museum culminated in an invitation to Mr. G. L. Bates (a well known African traveller and one whose name will be associated by readers of DISCOVERY with many outstanding journeys in West Africa in search of birds) to accompany him to Jidda and there put him in the way of more serious bird collecting than had been possible up to that time. Bates spent four months collecting in Arabia, mostly in the environs of Jidda, and many interesting birds were obtained; but it was to Philby himself, after Bates had returned to Europe, that the greatest discoveries fell. That very remarkable thick-billed lark, known to ornithologists as *Rhamphocorys Clot-bey*, hitherto believed to be peculiar to the deserts of northern Africa, was found to inhabit the desolate calcareous desert near Riyadh. Though newly discovered in Arabia, this was not a new bird; but there were new species awaiting discovery in Arabia and Philby collected several. By far the most interesting find was that of a black-throated chukor or rock-partridge, which has been named *Alectoris græca philbyi*. It was first obtained in the mountains around Taif and lives apparently at altitudes of 6,000-7,000 feet. Its nearest relative inhabits the mountains of Sinai. Since the type was secured Philby has sent several others to the British Museum. An illustration is given of this bird from a drawing by Mr. Gronvold, through the courtesy of the Editor of the *Ibis*, and of Mr. Bates. It will be seen that it is a fine handsome bird (p. 261).

Philby's second sensational discovery was of an entirely new genus and species of woodpecker which bears the name *Desertipicus doræ* in honour of Mrs. Philby who has shared so many of her husband's hardships. The idea that a woodpecker of any known species should inhabit such a country as Arabia at first sounds fantastic, but not only was it the case but the birds which Philby shot and sent to the British Museum were pronounced to have no near relative at all. It too was secured at a high altitude near Taif, and others have since been found at lower elevations. A figure of this new woodpecker is also included from the same source as that of the chukor, and my acknowledgments are due to Dr. Ticehurst and Mr. Bates for the loan of this *Ibis* plate (page 261).

[*From Whitaker's 'Birds of Tunisia'*

*The Desert Eagle-Owl* (Bubo ascalaphus desertorum), *discovered inhabiting the crags of the hills about Hufuf by Major R. E. Cheesman.*

Within the last few months two more new races—a new Scops owl and a new golden cuckoo—have been added to the Arabian list by the same indefatigable explorer, and it is safe to predict that there will be yet others to come. Indeed, since this article went to press a further collection of birds from the Hadhramant has arrived at the British Museum, presented by Mr. W. H. Ingrams, which contains a new race of Lichenstein's sandgrouse.

Enough has been written in this article to show that the time is not far distant when we shall no longer be able to point to Arabia as the greatest blank on the ornithological map.

# The Future of Industrial Peace

By J. H. Blaksley, M.C.

*Ignorance of psychology and neglect of economic axioms offer a sure road into the morass of industrial unrest. Captain Blaksley shows how, with a little exercise of reason, such dangers may be avoided, at the same time calling attention to some disquieting modern practices.*

SYMPTOMS make it difficult for us to hope that the industrial peace which we have enjoyed since the general strike will continue for another decade. An individual experience is only a pointer, but in my talks with employers and employees throughout the country I have heard more of industrial unrest during the last six months than I heard in the previous six years. It is of the first importance that we should anticipate the threatened trouble and not wait until it is upon us.

The reasons often alleged for the change of attitude are the tendency for prices to rise and the financial recovery of the trades unions from the strain of the general strike. They are the occasions rather than the cause. It is true that, if money wages do not rise with retail prices and without a long time-lag, real wages are reduced and discontent is the result. But up to the present the rise in retail prices has been small and wages are tending upwards. And in the unions the moderate element is now stronger than the extreme left wing, and the moderates desire strikes even less than other members of the community. The occasional breakdown of negotiations between employers and the unions must not cause us to forget that the great majority of differences are settled amicably without the public knowing anything about them.

## The Position of Economics

The problem of industrial contentment needs examining from the economic and from the psychological approach. The science of orthodox economics is now somewhat discredited. It was the idol of the 19th century, because its emphasis on the importance of production coincided with the self-interest of employers. But its fight for the gold standard in 1931 and the happy results of its defeat are still fresh in our minds. Many people would agree with a M.F.H. (whose gifts are not academic) who said to me at the time: "There are only two men who pretend to understand the financial crisis, and they hold diametrically opposite views. It's no good for me to think about it." But economics must not be blamed when economic principles are violated, as, for instance, after the war when we tried to extract an indemnity from Germany while we refused payment in goods or services, and in 1931 when we were buying more than we were selling and spending more than we were earning. Economics is national housekeeping and it has certain axioms which nothing can change. Wealth, for example, can never consist of pieces of paper or of pieces of metal called pounds, francs or dollars: it consists of the commodities which these tokens will buy. Production must be continuous because commodities are consumed or wear out: otherwise the community grows poorer. Distribution must follow production: you cannot distribute what you have not got. But unless there is adequate machinery for distribution (*i.e.*, purchasing power) much of what has been produced will be wasted. Attempts to thwart the laws of economics are as unpractical as attempts to make water flow up hill. They may achieve some immediate good, but the price invariably is a greater amount of harm. The action of sentimental clergy and others who advocate uneconomic policies is unchristian because it is cruel. And unfortunately there is often a conflict between what seems socially desirable and what is economically possible. At Dartington in South Devon, for example, there has been in operation for some years an interesting sociological experiment for co-ordinating agriculture and rural industry by the intensive development of an estate. But the example has not been widely followed, attractive as it must be to many landowners, because it does not appear to comply with the laws of economics in providing the current rate of interest on capital and adequate reward of risk.

## A Revolution Averted

What we want is not to run counter to economics, but to make our economic science more complete than that of the 19th century by balancing the claims of production with recognition of the importance of purchasing power and of the economic value of human life. The wage-earner is now the centre of political gravity. But although he is the "top dog" in politics he is still the "bottom dog" in industry, and sooner or later he will use his voting power to put an end to this contradiction, if his industrial position does not satisfy his conception of justice and his common sense. After the war we were often as near to revolution as we were after Waterloo, and that was very near indeed. For the whole of the summer of 1921 we had a defence force mobilised for action, and the general strike, which we are now inclined to think of as a comedy, was a still more serious crisis.

Statesmanship, however, has weaned the national mind from revolution to economic sanity, and the wage-earner seems now to appreciate that wages just as much as profits are derived from the proceeds of industry, and that production, therefore, is vital.

He is less convinced that there is economic and equitable distribution of the products of labour and of the amenities of life; and very often he is right. For example, since human fatigue is an economic factor of the first importance, it is more economic (as well as normally more equitable) for 199 men and one employer to bicycle to work on 200 bicycles costing £5 apiece than for the employer to come in a motor car costing £1,000 and for the men to walk, though it may be still more economic for the employer, with problems on his mind, to use a £200 motor car and for the men to use £4 bicycles. Employees do not resent an employer being comfortable in the interests of efficiency, and they realise that he is entitled to the stimulus of reward. But normally the curtailment of luxury expenditure is only uneconomic if it destroys the incentive to work, and employees very properly resent the expenditure for the sake of display which surrounds them at every hour. A few years ago an employer spoke to me of the unfairness of Morris Motors in changing the shape of their bonnets when the new bonnet was no better than the old. It had, he said, cost him about £70 to change his perfectly good car for a new model. When I asked him why he had made the exchange, he answered with a look of surprise: "Surely you don't suppose my wife could be seen driving about in an old fashioned car!" Plutocracy and pretentiousness are not only the enemies of democracy: they are the enemies of all that is best in the English tradition.

### The Key to Industrial Peace

It would seem then that, considered from the economic approach, the key to industrial peace is the maintenance of high production balanced by adequate purchasing power, and the equitable distribution of the proceeds. The importance of the first needs to be impressed upon the leaders of working-class thought by constant explanation and illustration. The second is best demonstrated by profit-sharing and bonus schemes devised as practical in particular businesses, and by the example of individual employers.

The psychological approach is more subtle. Hard as it is to generalise, we must begin by glancing at the attitude of mind of employers and of employees. There is no such thing as an employer class. Many so-called employers are the salaried employees of companies; and, apart from this, business executives vary in brain power, character, and outlook more than any other section of the community. Some are as enlightened and high-minded as any men in the country: others are so limited that they would do a public service by retiring into private life. Some treat their subordinates with consideration and absence of patronage, like the best of our landowners: others, if they dared, would terrorise them into virtual servitude. And there is infinite variety between the extremes. Generally speaking, however, the technical abilities of employers are much in advance of their general qualifications for administration and leadership; and this is an important factor in industrial relations, where personality counts for so much.

### English Psychology

The employee is still demanding of society the three things which have been the driving force of the Labour Movement all along—security, opportunity, and justice. Until recently his immediate ambition was almost always to secure higher wages: even when he fought for shorter hours, hope of extra pay for overtime was seldom absent from his mind. But now, with the all-round rise in wages and the extension of the social services, he is often coming to find that he has enough money to maintain his standard of living, and he is directing his thoughts to greater leisure and to a more satisfying and more enjoyable form of life. He has been affected even more than his employer by the mechanical environment of his working and his leisure hours. His mind is of the town and of the group, and in some respects he has less independence of character than his ancestors of the land and of the sea. Trade Unions and collective bargaining, besides protecting him from exploitation, are suited to his psychology. He is not an extremist, and with his mistrust of abstract ideas he shares the English love of compromise. As John Stuart Mill once cynically remarked: "There is no proposition, however absurd it may be, which the average Englishman will not accept if you put it to him as the mean between two extremes." The spread of democratic sentiments has weakened his respect for authority in Church and State, and he shares with other classes of the community in his weakness of a sense of discipline. But force of habit and fear of the unknown are fundamental characteristics of human nature, and like most other human beings and all animals he is by nature conservative. And his instincts are fundamentally sound; the holiday spirit of the Coronation would not have expressed itself in the startling display of bunting in our poorest streets if the heart of the people had been disloyal.

On the psychological side the chief weaknesses of industrialism are lack of tradition and lack of leadership.

The sifting of the centuries makes tradition a powerful factor for good in an old country like England unless it becomes hide bound by adherence to the letter at the expense of the spirit. The tradition, for example, of the responsibilities of landed property has been of great service to the community; but its restriction to *landed* property alone, coupled with the snobbish idea that trade and commerce were degrading to the landed class, caused 19th century industrialism to develop on utilitarian principles and without responsible leadership. Industrial management needs a sound tradition just as much as estate management or the professions. Take, for instance, the army, where tradition perhaps counts for more than in any other walk of life. The weakness of the army tradition is the undervaluation of brain power: greater battles than Waterloo have been lost in the class rooms of our public schools. But in the art of leadership this tradition is unsurpassed. It would be as unthinkable for an officer to "twist" his men or to trade upon inside knowledge as it would be for him to shirk danger in battle. Yet in industry sharp practice towards subordinates is sometimes considered good business. I can think of cases where large numbers of employees from all parts of the country have been invited to "democratic" conferences and where the inner rings of employers have had carefully prepared agenda with practised speakers in readiness, so that the resolutions they desired, and none others, could be passed in the name of the delegates. As though employees would not ultimately see through the pharisaism of cloaking dishonesty with technical correctness!

### Leadership

Happily the number of employers who would despise Pyrrhic victories won by craft is increasing every day. I notice this more and more, especially among the younger generation, in my travels about the country. One example will suffice. Quite recently I called on an employer in a poor part of London. He had been educated at Oxford and had lost an arm in the war. We were discussing industrial relations, and I asked him how he got on with his own work people. "No trouble at all" was his answer. "I treat my men exactly as I treated my soldiers. Englishmen are always all right if they are properly led." One of the few good results of the post-war economic pressure on the leisured class has been the entry into business of more men with traditions of leadership, who feel responsibility to their subordinates, and realise that the goodwill of a happy staff is the best business asset of a firm. As Mr. Attlee said of Mr. Baldwin (as he then was) in the House of Commons a few weeks ago, the right sort of employer never victimises his employees, first because it would be an abuse of power and secondly because it would be stupid.

Happily too the new type of employer is sufficiently sure of his social position to distinguish between dignity and pomposity. He would not—like a big employer I met the other day—keep a subordinate standing for an hour while he sat at his desk, and he does not feel ill at ease when mixing and talking with his men. The latter point is very important in promoting happy relationships. Take the question of the works canteen, a matter on which employees are sensitive, especially if they live at a distance from the factory and the canteen is a virtual monopoly. If a director who occasionally goes round dinners with his canteen manager finds a complaint, he can take a piece of food off the man's plate and eat it himself on the spot, as an officer would do in a regiment. Then he is in a position to deal effectively with the man for complaining without cause, to dress down the canteen manager for neglect of duty, or to send for the contractor, as the case may be. The rank and file always appreciate vigilance by higher authority as a precaution against abuse of power by middlemen, and the director who establishes personal contact with his men and shows them that he himself will see justice done will reap his reward in their confidence and in the enhanced morale of his works.

Lord William Cecil, the late Bishop of Exeter, once wrote: "In many ways the artisan and the farmer are in more sympathy with the old squire class than is the man . . . of newly acquired wealth."* The employee who fights irresponsible riches is defending the English tradition just as much as the employer who fights revolutionary communism. On the success of both battles the future of our industrial relations depends.

## New Sussex Excavation

An appeal for funds is issued for the excavation of the Angmering Roman Villa site, which is under investigation by a committee acting on behalf of the Littlehampton Archæological Society in co-operation with the Sussex Archæological Society. This site was first discovered in 1819, when a Roman bath, hypocaust, sudarium and sewers were found. The bath, rediscovered early this year, comprises many rooms, some with hypocausts, grouped around a tank. As the bath building is exceptionally rich in its internal decoration, the villa, if, as is probable, it corresponds, should prove a remarkably fine example of the Romano-British country house. The sum required is at least £500. Donations may be addressed to DISCOVERY Office.

* "*The Old Squire and the New*," *An Essay in Facing the Facts*. (Nisbet, 1912.)

# Is Rocketry Progressing?

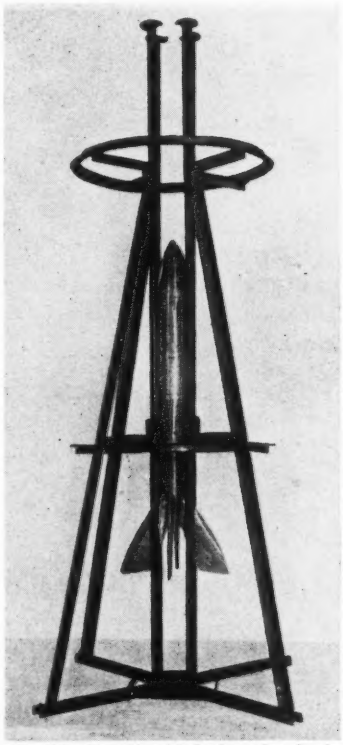
**By Charles G. Philp**

*Author of "Stratosphere and Rocket Flight"; "The Conquest of the Stratosphere"; etc.*

*Research into the problems of rocket-propulsion with a view to exploring at a great height has been progressing quietly and steadily for some years. Mr. Philp describes the steps so far taken and indicates the rather unexpected direction towards which the attention of rocketry experts has lately been diverted.*

ALTHOUGH numerous demonstrations of rocketry have been staged in the past, such demonstrations cannot, in all fairness, be said to have been of such a nature as to impress the average aeronautical engineer. Nevertheless, far greater progress has actually been made in rocketry than the past disappointing public demonstrations would indicate, and the public, generally, has little idea of the vast amount of competent scientific research already accomplished.

The more responsible rocket experimenters realised long ago, that before the rocket can be successfully harnessed in the service of man an immense amount of experimental and theoretical work must first be carried out. They believe, and rightly too, that they will be rendering rocketry far better service by attacking the problem under laboratory conditions than by immature and premature public demonstrations of rockets in actual flight. Instead of spectacular rocket shots therefore, they have, for several years past, concentrated their energies on experiments dealing with the very large number of problems requiring solution before rocketry can possibly become of practical importance.



*Oberth's first liquid-fuel rocket in its launching-rack.*

So that we may the better appreciate the nature and extent of the experimental work in question, the following brief résumé of the fundamental problems of rocket research are given. Because combustion in the gunpowder rocket was uncertain and generally uncontrollable, liquid fuels, which could be controlled quite easily by valves, were substituted. After much experiment and research the following mixtures were found most suitable: (*a*) liquid oxygen and alcohol, (*b*) liquid oxygen and gasolene, and (*c*) liquid oxygen and liquid hydrogen. The application of liquid fuels changed the situation completely and necessitated a large amount of experimental work to find the proper construction of combustion chambers and nozzles, and various methods of fuel injection.

Confronted with combustion temperatures well over 3000° F., at which temperature, combined with high pressure, tough alloys like manganese-bronze melt like butter, the construction of suitable combustion chambers and ejection nozzles proved to be a problem of the first magnitude.

It must be borne in mind that the constant flame temperatures in the rocket combustion-chamber exceed that of any other type of high temperature technical furnace, such as the internal combustion engine (2200° abs.) or autogenetic welder (3500° abs.), and that the highest melting points of of the best known refractory linings such as graphite (4000°), tantalum hafnium carbide (3900°), niobium carbide (3800°), thorium oxide (3000°), etc., do not reach with their melting points the temperature of the flame.

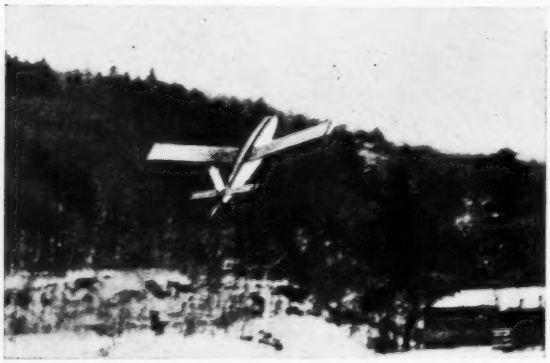
Four methods of getting over this difficulty have been, and are being, investigated: (*a*) the use of a metal like molybdenum or tungsten, whose melting point exceeds that of the flame temperature; (*b*) cooling the chamber by circulating the fuels and the liquid oxygen through its walls; (*c*) use of a refractory such as carborundum for a lining; (*d*) injection of water to create a layer of insulating steam on the *inner* walls of the chamber and nozzle.

That the problem is not insoluble is obvious from a simple fundamental experiment. If we connect to a water pipe an ordinary metal tube of steel, copper, brass, aluminium, or the like, of about 10 mm. internal diameter, and try to melt any thickness of it by an oxy-acetylene flame, we find that as long as the speed of the water inside of it remains high enough, the metal tube does not become even *visibly* warm! This despite the

fact that the welding flame temperature is about 3500° abs. The superficial, poorly conducting, layers of the tube burn off, and quickly melt away, but the metal tube itself remains undamaged and will not even glow, being heated to only a few hundred degrees. And when it is appreciated that a combustion chamber the size of a hen's egg, and weighing one pound, will develop a thrust of 85 lb., at 300 lb. internal pressure, it will be readily seen that wall cooling is far from being an impossible proposition. Even a rocket chamber capable of delivering 200 h.p. weighs only 14 lb. and, relative to the power evolved, the cooling of such a small superficial area by means of the coldest cooling materials (liquid gases), under high velocities of circulation, seems perfectly feasible.

Other practical problems which have been investigated on scientific lines are the arrangement of the fuel chambers and the provision of fuel feeding systems which do not require pumps, and, in general, dependable apparatus for the continuous measurement of the fuel flow, the jet reaction, tank and combustion chamber pressures, the exact flame temperature, the jet velocity, and the chemical analysis of the jet gases.

No more interesting example of the intensive and specialised treatment of the problem of rocket flight could be given than that of the work of its pioneer worker, Professor Goddard. Professor Goddard started experimental work with rockets over twenty years ago, and in 1919 published the results of his experiments under the title "A Method of Reaching Extreme Altitudes,"[1] by which he verified his previous belief that the rocket would function as effectively, or more so, in a vacuum.



*The first Rocket Mail Plane in flight above Greenwood Lake, about fifty miles from New York, February 23rd, 1936.*

He continued his experimental work for seventeen years before he published a further report. This was published as recently as March 1936 under the title "Liquid-Propellant Rocket Development."[2]

Professor Goddard's manner of attacking the problem of rocket flight is an amazing example of tenacity of purpose, and is conclusive proof of the meticulous and exhaustive manner in which rocket experimentation of to-day is being carried out. For several years following his publication of 1919, Professor Goddard, aided by a meagre grant from the Smithsonian Institute, quietly went on with his experimental rocketry. Satisfied that liquid fuel was to be preferred to powder fuel, his first task lay in deciding on the best combinations. After three years' work he decided that the most practical combination was one of liquid oxygen and gasolene. He then decided that the most important factor in the development of rocketry was adequate control.

First he directed his attention to the so-called "nose-drive" construction, only to discard it in favour of a pendulum device. This, in turn, gave place to a system of small gyroscopes which actuated vanes in the exhaust jet of the rocket motor when the axes deviated more than ten degrees from the vertical. It was not until March 1936 that Professor Goddard was able to announce to the world that he had at last successfully achieved stabilisation of the rocket by this means.

Having thus achieved stabilisation of the rocket in flight, Professor Goddard is now directing his efforts to the problem of weight reduction, and to the investigation of new light-weight and heat-resisting alloys. He is confident that he will be able at an early date to produce a meteorological rocket capable of ascending to a height of 50 miles or more. To indicate the general progress made by Professor Goddard, it may be mentioned that in March 1926 his first liquid fuel rocket attained a height of 184 feet in 2.5 seconds, which is equivalent to a speed of about 60 m.p.h. Nine years later, on October 14th, 1935, his latest-type rocket rose to a height of 14,000 feet and attained a speed of 700 m.p.h.

It must be obvious to anyone that there is a vast difference between exhaustive scientific research of this kind and the mere shooting of a *powder* rocket with a small packet of letters in its nose. There are also other very cogent reasons why practically all rocket experimental work of any real scientific importance is carried out at the "proving stand," and why such actual shots as may be necessary are made with "pure" rockets, of "model" size, notwithstanding that the ultimate aim of all such experiments is the production of a passenger-carrying rocket plane.

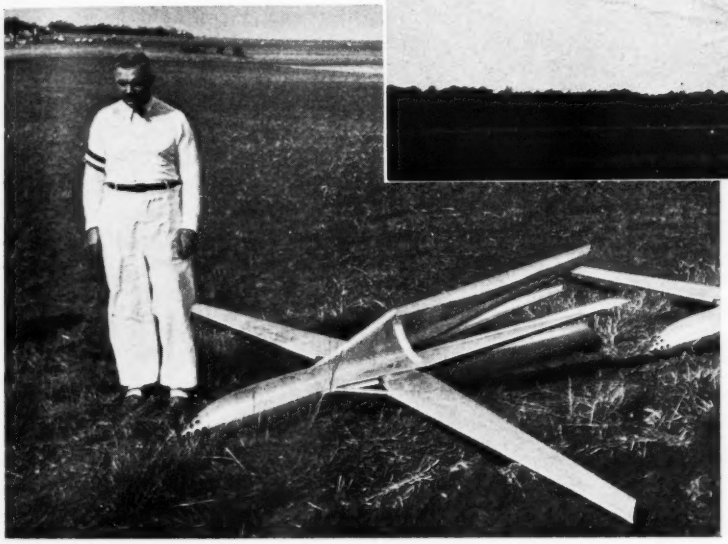
Unlike aviation, rocketry is severely handicapped in

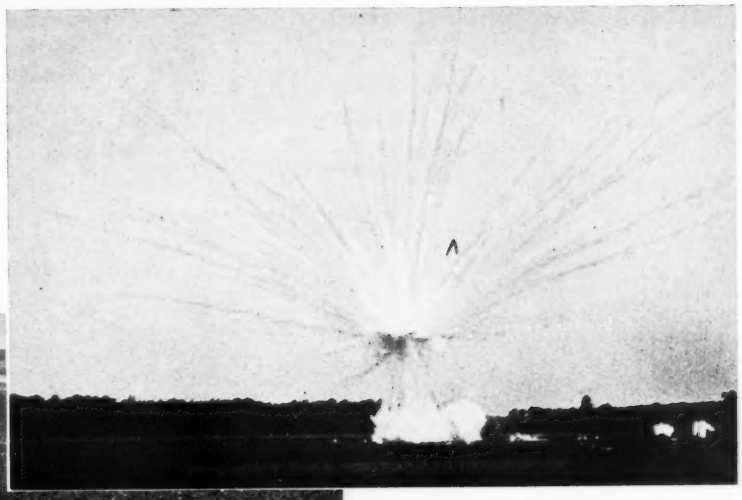
[1] *Smithsonian Misc. Coll.*, 71, II (Smithsonian Inst., Washington, D.C.; 25c.) Out of print.

[2] *Smithsonian Misc. Coll.*, 95, III. (Smithsonian Inst., Washington, D.C.; 25c.)

its progressive development by the fact that all experimental work has to be carried out in a medium totally unsuited for the purpose. It cannot be too strongly emphasised that the real home of the rocket plane is the virtual vacuum of space.

Long before the scientific world had appreciated the importance of Professor Goddard's discovery, he had found as a result of his pre-1919 experiments that enormous initial velocities were essential, if the fuel used was to produce maximum results. Later studies have shown that at 25 m.p.h. a rocket utilises but 1.2 per cent. of the fuel's energy, at 65 m.p.h. 2.8 per cent., and even at 350 m.p.h. only 13 per cent. of the possible fuel energy is being obtained. For anything like a practical expenditure of fuel a speed of a mile a second (3,600 m.p.h.) is essential. Such prodigious speeds seem fantastic at normal levels under aviation conditions, but in space, where every propulsive impulse gives an incremental addition to the previous speed—there being no frictional retardation—such speeds are easily and quickly attained. Obviously it would be quite impossible to experiment, at normal levels, at these enormous speeds, with any form of vehicle equipped with aero wings, since they would be snapped off by the terrific air resistance they would encounter at the start. Hence experimental work aimed at the production of a rocket plane, must of necessity be made with " pure " rockets, and it is, generally speaking, of little or no consequence whether such rockets are " models " or of full man-carrying size.





*On the left, Reinhold Tiling, one of the pioneers of rocketry, with his altitude powder-rockets. Above, explosion of a Tiling Rocket in mid-air.*

Once, however, the rocket motor can be made to lend itself to adequate control, as a result of these " proving stand " and " model " tests, and is proved to be no less docile than the internal combustion engine, the application of the rocket motor for the propulsion of stratosphere planes is assured. It has to be admitted that progress in this direction is painfully slow, but this is inevitable so long as the expense of the necessary research work has to be borne by a mere handful of enthusiastic supporters—Professor Goddard's work alone excepted.

Nevertheless, before very long, rocketry is likely to see early and important developments. At long last, the military authorities of several countries have realised the extraordinary potentialities of reaction propulsion, and in well informed rocketry circles there are strong rumours that the British Government has actually started work on the first military rocket plane. The reason for this sudden interest by various military authorities in the rocket plane arises from the peculiar

(*Continued on p.* 277)

# The March of Knowledge

**Stronger Cast Iron**

New forms of cast iron, which are three times a strong as normal cast-iron, 500 times as resistant to attack by certain acids, and harder than any known cast metal, were described by Dr. A. B. Everest before the Chemical Engineering Group Session at the annual general meeting of the Society of Chemical Industry at Harrogate recently. On the point of strength, Dr. Everest stated: "It has been customary in the past to estimate on a mechanical strength of only some 7 or 8 tons per square inch. By the use of alloy additions, and especially by the use of special methods of preparing the base iron, it is now possible for engineers to expect a figure at least two or three times this value, and in fact to-day it is quite usual to obtain a strength of 22-25 tons per square inch in large castings."

**Natural Ice-Box**

An attempt is to be made to utilise the permanently frozen subsoil of Anadyr, U.S.S.R., for the preservation of fish, of which there is an abundance in the waters of that area. The soil of the region has a stable temperature of about 27° F. in the upper layers and, in the opinion of authorities, can be utilised as a natural refrigerator for fish. The shortness of the fishing season at Anadyr (it lasts only about a fortnight in the year) makes it impossible to use the catch to the full, as the preservation of large quantities of fish in summer would entail the construction of costly cold-storage plants. Experiments already made in utilising the permanently frozen subsoil for preserving fish have been successful. It was found that fish preserved in closed containers in the frozen subsoil for two weeks were in a condition as good as fish kept in artificial refrigerators.

**Alumina Production**

A new process for the extraction of alumina from bauxite, known as the Séailles process, after its inventor, and said to permit the use of cheaper grades of siliceous bauxite and to give valuable by-products, begins with the production of crude calcium aluminate by calcining a mixtuie of bauxite and limestone. Hitherto calcium aluminates have been obtainable only by calcination of the raw materials at a high temperature; in the Séailles process, however, the calcination takes place at a relatively low temperature (950° C.-1100° C.), the calcined product is friable and easily ground and its solubility in water is at a maximum. It is claimed that siliceous bauxite may be used without disadvantage, thereby eliminating one of the chief drawbacks of the well-known Bayer process. The crude calcium aluminate is next treated with water on the counter-current principle, and the resulting solution of calcium aluminate is filtered and immediately treated with purified carbon dioxide obtained from the first calcination, whereby a mixture of anhydrous alumina and calcium carbonate is produced. The final separation of the alumina can be brought about by treating a suspension of the mixture with water saturated with carbon dioxide, when the calcium goes into solution as bicarbonate, leaving a residue of alumina containing not more than one per cent. of calcium carbonate.

**Plastic Windows**

The embodiment of a streamlined observation car in the L.N.E.R. Coronation Express (picture p. 259) has been made possible by the use of the transparent plastic "Perspex." This material has, among other advantages, the property of being mouldable to shape, and has enabled the L.N.E.R. to use the "beaver tail" as a contribution to streamlining the fastest train in the Empire. Another property of "Perspex" is its very high transmission of ultra-violet light, adding to its success in this use.

**Snow Research Drills**

For the investigation of the transition between the nearly solid "firn" snow and actual ice, Gerald Seligman reports that special drills on the model of the prospectors' tools have been constructed, which can bore down through the surface of the great permanent snowfields and bring up samples from successive depths, so as to show the gradual disappearance of the air between the snow crystals.

**Roman-Saxon Occupation Site**

Particulars of a Roman and Saxon site at Elmswell, East Yorkshire, two miles west of Driffield, are given by Mr. Anthony L. Congreve in a pamphlet issued from the Hull Museum. No definite buildings were revealed, but a rectangular stone floor, 20 ft. by 10 ft., was uncovered, with a roughly circular hearth to the north-east, and to the south-west a pit filled with sooty black soil in which were made many finds, including a small bronze of Constantine II (A.D. 337) and fragments of Samian ware. Other Roman pottery, coins of the 1st-4th century, and pieces of Saxon pottery were likewise found, affording apparent evidence of continued occupation through the Dark Ages into Saxon times.

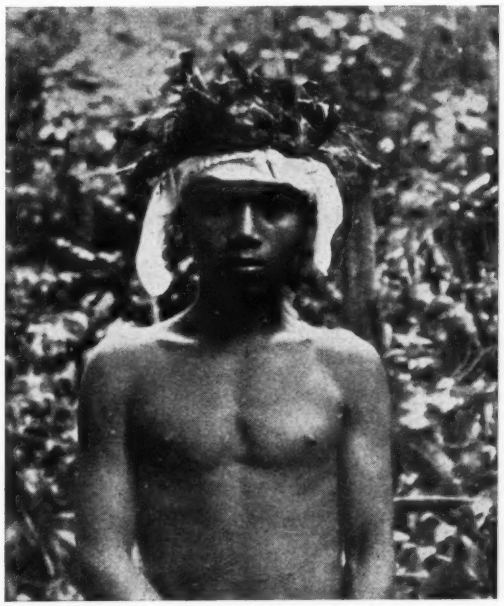
# Among the Primitive Sakai

**By R. O. D. Noone.**

*The little-visited Temiar Sakai are among the most interesting of the peoples of Malaya. The Federal Government wisely discourages indiscriminate visits to their primitive communities, but Mr. Noone received a personal invitation from a local chief. His account of the recreational and ceremonial dancing is especially noteworthy.*

Not so long ago if anyone had a desire to come into contact with uncivilised peoples, elaborate arrangements were necessary. Months of preparation usually preceded the departure of the expedition. Nowadays some first-hand experience of primitive cultures is almost a commonplace to the ordinary tourist out East.

In July last year the Federal Government Ethnologist of Malaya was engaged in excavating several skeletons of prehistoric man in the vicinity of Sungei Siput, when he received an invitation from a friendly chief of the Temiar Sakai to pay a visit to the tribe. A party of nine Temiar braves, especially chosen to form the escort, brought the invitation. The importance of his work—it was hoped that these researches might provide a link between the prehistoric peoples of Malaya and Java—necessitated the Ethnologist's constant presence at the excavation. It was not so, however, with his younger brother (the author) and a friend (Gerald Thunder) at the time staying with him. So it was eventually decided that these two should return with the deputation. The Temiar consoled themselves by saying that if their "Father" was not coming with them, they at least had his brother to whom they gave the name "Little Father." Incidentally he topped the tallest of them by six inches.



*Andor, our Temiar cook, a fine type of this unspoilt jungle race, and an expert with the blowpipe.*

On the evening of the nineteenth of July we and our nine Temiar companions, loaded with zinc provision boxes and camp equipment, caught the night mail at Ipoh (Perak State) for Tapah Road. Thence we motored to Cameron Highlands, 5,300 feet above sea-level. Next morning we set out led by Anga, a Temiar sub-chief who acted as gunbearer. The river Telom was soon reached, forded, and followed towards its junction with the river Jelai. The pace we had to keep up was a revelation as, even though their path brought them swamp, jungle, or boulder-strewn hills, the Temiar scarcely ever altered their rate of progress. The hot clamminess of the matted jungle was oppressive but we soon learnt to prefer it to the burning heat of the rockstrewn hill-sides.

Shortly after noon we arrived at an old native shelter. Imagine our surprised delight when Andor, our Temiar cook, presented us with cups of tea immediately on our arrival. Unnoticed by us he had dashed on ahead from the last halt to prepare camp for our occupation. The shelter in which we were to sleep, although primitive, had been neatly constructed and served its purpose of protection from sun, rain and mild floods. The floor, supported five feet above the ground on wooden posts, was made of semi-split bamboos flattened out into the form of planks and laid on cross members, the ends of the bamboos being held down by thin *rotans* (long cane creepers).

The neighbouring Lake Lubok Nanga, which means the "Dragon Hollow," was the only place where we saw any indigenous fish, the Telom and its tributaries being some of the rivers that a benevolent Government had stocked with trout from England. These "overseas" trout are accused of having eaten up all the native fish, and as during the next year or two they are under Government taboo, the jungle folk in the Telom area have altogether lost what previously formed a large part of their diet. The Sakai have no desire to catch or eat trout, having decided that they must be "disgusting sea fish," having come from "over the sea." To the best of our ability we tried to make the Temiar understand the great value and delicacy of the trout as a food.

As the sun rose we began another long and strenuous

day's march. We noticed that where tree trunks had fallen across the trail, our companions, instead of climbing over them and then proceeding straight ahead, would make their way along the top of the trunk. At the end of the tree they jumped down, cutting a fresh path back to join the original trail. It may be that ignorance of what is sheltering below the further side of the trunk forbids a rash jump over the obstacle.

A couple of hours after starting the day's march we came to a place in the river where we had to cross against a very powerful and vicious torrent. Carrying our equipment and provision boxes on their heads, the bearers struggled through the seething waters, which reached to their armpits, and threatened to wash some of the smaller men away as they reached the full force of the current. The first two men across dumped their burdens on the bank, and returned to our side of the river. From their many gestures and from the few words we knew, we understood that it was their intention to carry the "tuans" across on their backs. Our self-respect prompted a laughing refusal to be treated as Nabobs; moreover the precarious progress of the bearers when crossing with the kit made it obvious that it was far safer for us to wade across. Our flounderings among the slippery stones would have been amusing but for the consciousness that any slip would probably have resulted in being washed over the waterfall (a 300-foot drop) that thundered two hundred yards downstream.

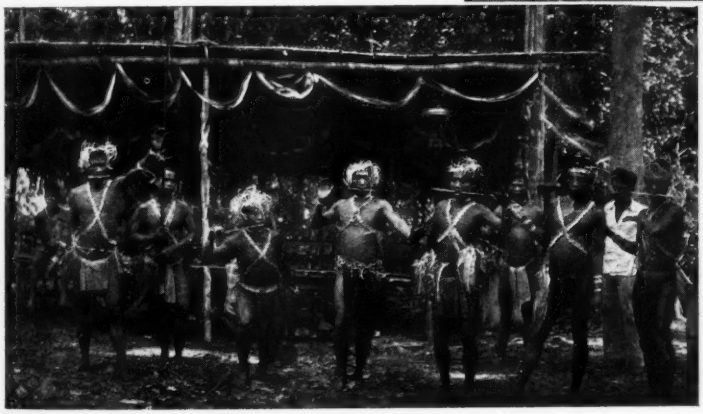
A second crossing of the river was perhaps more hazardous than the first. A huge tree trunk about a hundred feet long, lying across the river, was precariously balanced on a big boulder near mid-river, with most of its length about ten feet out of the water. The Temiar assured us that this freakish bridge existed previous to my brother's first visit, some six years ago, and although we pointed out that the trunk had rotted and was wearing through, they "did not think the tree would break in halves just yet." With a feeling of emptiness we scrambled on to the tree trunk and gingerly followed the leading bearers. At the point of balance the diameter of the tree had increased to about four feet but our pace automatically slowed as the sight of the hungry waters reaching up from the jagged boulders underneath, and the swaying action of the trunk induced giddiness. The Temiar in front and behind, mistaking our pause for over-nervousness, simultaneously scrambled on to the ends of the trunk to dash to our rescue. The two actions resulted in an increasing see-saw movement and the ends of the bridge were soon rising and falling some six feet. Signalling to the bearers our intention to move on we proceeded along that heaving trunk to find that the root end, due to the hollow in the bank formed by the uprooting, was still moving up and down several feet. There was nothing for it but to wait till the "bridge" became steadier before risking a jump to the bank, as a slip into the mortar of this huge pounding pestle would have resulted in a fatal crushing. Jumping safely ashore we decided that the experience warranted an immediate light lunch on the spot.

In half an hour we were again on the march. The stamina of our bearers amazed us. During the past six hours they had carried heavy loads through the sweltering heat of the jungle, yet after our half-hour's rest they resumed their burdens with alacrity. Late that afternoon we crossed the river once more. This time there was neither fording place nor bridge, only a tough creeper about an inch in diameter stretched from bank to bank, about eighteen inches clear of the water. As we pulled ourselves along the creeper, hand over hand, the current was so strong that our bodies were almost carried above the surface, the keeping of our heads above water being almost as much as we could do. We wondered how on earth the bearers with their heavy loads were going to cross. Our fears were needless, for the Temiar made the traverse with speed and assurance, lunging from hand-grip to hand-grip. An hour or so later we were delighted to see the worthy Andor, who had hastened ahead, sitting outside two dilapidated leaf shelters, holding ready steaming cups of tea.

After breakfast next morning, Anga, our guide, who was head of the community on the opposite hill, invited

*A characteristic view in the Perak jungle.*

us to visit his Longhouse. This was the first Temiar communal dwelling-place we had seen, and we welcomed the chance to inspect one at close quarters. The Longhouse was situated at the top of a hill overlooking the junction of the Kerlah with the Telom. To reach it from the foot of the hill we passed through a tunnel in the matted and overhanging vegetation, an ideal place for an ambush. The Longhouse itself covered an area of about 120 feet by 20 feet, and was supported eight feet from the ground on wooden posts. Climbing a sort of bamboo ladder we entered the main door of the building. Though flimsy in appearance this dwelling place was cleverly constructed of bamboo and palm leaves (*atap*) laced tightly together with *rotans* to form the walls and the roof. Looking from the middle of the main floor, we saw little cubicles along the



*Above: Three Temiar wives, the girl in the centre a newly-married bride.*

*Left: Temiar recreational dancing; note the drummer in the left background.*

walls, which reminded us of stalls in a large stable. These cubicles, which were built next door to each other, were partitioned off to a height of about four feet with *atap*. The floor of each cubicle was made in the same way as that of the shelter in which we had slept two nights before, that is bamboo slit here and there lengthwise and split open to be pressed flat in the form of a board. These were lashed to the main floor and supported by stout posts. The external wall of each cubicle was arranged so that it could roll up during the day like a blind to admit light. In each of these little rooms, ten feet by six, there lived a family composed of a man, probably two wives and his children, who in number might be as many as six. There were fifteen of these family sleeping rooms, each with its little door giving access to the main floor, the family cooking fires being near this doorway. The fire was made up on a thick layer of earth and clay, forming a hearth to protect the main floor. This hearth, about four feet square, was held together by a framework of bamboo and on it small logs were arranged like the spokes of a wheel, the centre of the spokes being the core of the fire. At night the flickering lights of the cooking fires were the only illumination in the whole building. There being fifteen fires, one to each cubicle, the main hall was fairly well lighted. The floor of the hall was constructed of thin slats of bamboo lying on cross members of about three inches diameter and firmly kept in place by *rotan*, thus forming a platform of surprising springiness. In the little space outside the cubicles, where each family dined, little openings, due to the drying and warping of the bamboo slats, had formed here and there in the floor. Through these scraps of food and refuse were dropped down to the penned in fowls beneath.

Having finished our inspection, Anga in his capacity as chief invited us to be his "food" guests. Seated on a small dais we began a meal of venison, Indian corn, bananas and Temiar tapioca. We could not eat anything like the quantities the Temiar consumed, so to avoid giving offence by repeated refusals we offered cigarettes and tobacco as a gesture of friendship. Anga

in turn presented us with two chickens for our evening meal. The rest of the day was spent in camp preparing a list of the more commonly used Temiar words and expressions ; a rather difficult job as there is no Temiar alphabet or grammar, consequently the words had to be written down phonetically.

Next morning we set out on the last stage of our journey, and about tiffin time we were glad to see smoke slowly curling upwards from the cooking fires of an enormous longhouse on the top of a distant hill. This was Regneng, our destination. We were received by the chief of the district, D'to Along, who invited us to enter and sit on his ceremonial mat on the dais. After exchanging greetings, the mat on which we sat was laden with the usual bananas, Indian corn and tapioca, as a sign of welcome. Later we were shown, with proud ceremony and solemnity, the " Proclamation of the Great White King " which granted this clan " complete protection from the interference of strangers in this reserved area which the White King had given." The only people allowed in these reserves were Government officials on business or guests invited by the Chief. Along, with all the domestic pride of a worthy house-proud woman, next showed us round this " whale " of longhouses. The plan of construction was similar to Anga's longhouse, but in this case there were more cubicles, and the main floor was larger and wider. There were approximately one hundred and forty inmates here, yet the general cleanliness and neatness of the people and their habitation was remarkable.

### Recreational Dancing

During the evening meal the various families had grouped themselves round their respective cooking fires and were now chattering and eating in the flickering firelight. The easy happiness of these people is doubtless due to the simplicity of their lives. It is well said that " That which you have never heard of, you never miss." These Temiar are blessed with a good physique, and although only averaging five feet four, or thereabouts, in height, are muscular and very well proportioned. A signal was heard for the dancing to begin, and some of the women began to strike the logs of the cooking fires with the hollow bamboo sections used for water carrying. These bamboos, being of various lengths and diameters, produce sounds differing in tone and volume, the combined effect of which was weirdly attractive. Gradually the women's rhythmic tapping attracted the attention of all the Temiar. One by one the men joined in the recreational dancing, with slow steps and body swaying to the beat of the resonant bamboos.

After some two hours of these exercises, and a short interval for preparations, the bamboos again began their tapping, but with a faster rhythm. This time they were accompanied by a hand-tapped Sakai drum, made from a hollowed-out piece of tree trunk and covered at one end with tightly stretched python skin. This was the signal to begin the ceremonial " Jinjang " dance. First one man, then another, decked with reed streamers, joined in, till eight of them began a long stepping march round the floor. The compelling rhythm of the bamboos and the drum soon affected the dancers, and they quickened their pace, by a combined movement of two steps forward to one step back, but still to the same beat. As they circled round they waved their arms in a scythelike motion at half the speed at which their feet were going. One after another they added another movement by bending and unbending the whole body line and a little later, becoming more abandoned, the dance developed into a circular, swaying movement of the body with waving arms and stamping feet. Profuse perspiration soon appeared on their bodies and the whites of their eyes became more pronounced. At the approach of exhaustion the degree of intoxication increased ; the dominating note of the drum seeming to draw them irresistibly towards it. Swaying up to it they droned a weird chant supported by a monotonous response from the women tappers. With a flourish of their ceremonial streamers each man bowed in front of the drum in his desire and preparedness to commune with their " Tiger Familiar "—(the beneficent guardian spirit of the tribe). Having thus made their obeisance they believe that the tiger familiar takes control of them and their actions as they return to the dance, whirling, twisting and stamping. In the last stage they lose all mental control and so fall to the ground in a trance. During this trance the body of the dancer is usually completely rigid. When a man reaches this condition the medicine man approaches him and blowing with short puffs through his half-closed hand on to the tense muscles simultaneously beats the body with palm leaves. This combined treatment of blowing and beating is continued till the spirit of the tribe signifies his departure by the dancer's return to consciousness. Should a dancer attain only a semi-trance he is capable of doing anything, so immediately his condition is recognised he is relieved of all his weapons and carefully watched. Luckily no serious development occurred during our performance, and with the recovery of the last from his trance the spectacular Jinjang was concluded.

When the time came for our departure, as a last gesture of friendship we arranged D'to Along and his people in a group and took their photographs. They expected to see the result extracted from the little " black box " at once, but we managed to make them understand

that this could not be done. We showed them photographs of other Sakai and these they liked immensely, because they recognised some of their friends. We marvelled at how they arrived at this because as often as not they insisted on looking at the photographs sideways or upside-down. To accomplish a hurried departure gracefully, we presented the Chief with a sheath-knife and distributed two pounds of tobacco among the others, to their great joy. We were both very sorry to leave these delightful people.

We returned by almost the same way as we had come, arriving at Kuala Kerlah in the midst of a storm which forced us to camp there till the morrow. Whilst on the march when the heat was intense, and when we were several miles from the river, we found we had run out of water. Pointing to our water flasks, we asked Anga to lead us to the nearest water. Understanding our need, he soon after stopped by a tree, up which a Temiar climbed about twenty feet, cutting down what appeared to be an ordinary creeper that grew straight up from the ground clutching the tree top some sixty feet up. With a clatter the bottom half of the creeper fell to the ground. Our curiosity aroused, we closely watched the next operation, the results of which astonished us. A drinking mug was unpacked and a few two-foot lengths about 2½ inches in diameter were cut off the creeper. Offering us the mug, Anga held the sections vertically over it, and we beheld seemingly clear water gradually flowing out. Only three sections were required to fill a half-pint mug, and as a drink the liquid was both delicious and satisfying. Subsequently I was repeatedly baffled in my attempts to find this creeper again.

About mid-afternoon we arrived at lake Lubok Nanga exhausted from the efforts of the day's long trudge, and not till next dawn did we prepare for our final lap. We packed the camp utensils and set aside enough stores to last us the day. The remainder we divided among the bearers, and then started off. Shortly afterwards Anga, who was ahead, suddenly stopped in a listening attitude and then looked steadily at a clump of bamboos. He advanced, and climbing the bamboo which had attracted his attention, he put his ear to a tiny oblong hole about eight feet up. Drawing his *parang* he cut out a bit of the bamboo and putting his hand into the hole, drew out with evident satisfaction a small bat. This kind of bat was specially valued, for certain parts of it were made into medicine, and the remainder was relished as a tasty morsel. How the bat came to be in the bamboo is a mystery, but perhaps a greater mystery is how Anga knew it. A few hours later we crossed the Telom for the last time and so struck the motor road to Cameron Highlands, where a shave and a hot bath brought us back to civilisation.

## Is Rocketry Progressing ?

(*Continued from page 271*)

characteristics of the "pursuit" type of military aeroplane. As most people are aware, the most vital function of a pursuit 'plane is to attain maximum elevation in a minimum of time.

The present type of pursuit aeroplane weighs perhaps some 4500 lb., and it can attain a height of 20,000 feet within eight minutes of the start. By equipping this type of aeroplane with rocket engines, complete with rocket fuel, an extra weight of 1000 lb. would be incurred —750 lb. of which would be fuel. A pursuit 'plane equipped with dual engines of this type—aero and rocket—would have its starting speed increased by 12 per cent., and its normal starting path which could now be made at an angle of 30°, would be shortened by fifty per cent. Using the rocket engines as an auxiliary to the aero engines, a pursuit 'plane, thus equipped, would attain an altitude of 20,000 ft. within one and a half minutes from the start, compared with eight minutes by aero engines alone.

Moreover, after using up the whole of the rocket fuel in this way, the flying weight of the dual equipped plane would be, for the remainder of its flight, only about 250 lb. greater than that of the normal aeroplane. And since the reaction thrust, acting from the extreme rear of the plane, is in no way different from the pull of the aero engine in its nose, and remains in fixed relation to the aeroplane axis, stability and flight-control are not interfered with.

This quite unexpected aspect of reaction-propulsion, while practically of no commercial value, from a military point of view is of the very greatest importance. As a result if is more than probable that the development of pursuit 'planes, thus equipped, will go a long way towards revolutionising progress in rocketry.

Finally, it should be observed that France—the first country to appreciate the aeroplane—is equally to the fore in rocketry. At the Paris Exhibition, this year, the Minister of the Interior has been broad-minded enough to order the Astronomical Section to include a sub-section on rockets and space flight. This is the first occasion rocketry has received governmental recognition, and is eloquent proof of the substantial progress it has made.

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Whitfield King's Standard Catalogue of Postage Stanps of the World for 1938 is the thirty-seventh annual edition of this work of reference. It records no less than 63,927 separate varieties of postage stamps, accompanied by more than 7,100 illustrations. The text includes currency and geographical notes on the countries concerned and prices have been completely revised to represent current market conditions. The retail price is five shillings.

# Luminous Phenomena of Earthquakes

By Charles Davison, Sc. D.

*An account of the phenomena accompanying recent disturbances in both hemispheres.*

FROM so long ago as 89 B.C. in Italy and A.D. 869 in Japan, strange luminous phenomena have been noticed at or about the times of destructive earthquakes. In 1910, Professor I. Galli compiled a catalogue of all the examples known to him. The total number was 148, but as 101 of these were associated with Italian earthquakes, the list is clearly incomplete. He divides the phenomena into four classes: (1) Flashes of light like lightning, luminous spots and narrow bands of light; (2) Globes, columns and beams of fire; (3) Flames, numerous sparks and luminous vapours; and (4) Diffuse lights in the air and luminous clouds. In 52 examples, the light was seen before the earthquake, in 37 with it, and in 20 after[2].

### An English Earthquake

Even if we admit that the luminous phenomena were clearly seen and accurately described, it by no means follows that they had any connection, direct or indirect, with the attendant earthquake. They might be due to fires, to distant flashes of lightning, to land-slides, to the sparking of electric wires, or to the passage of bright meteors. One of the most remarkable examples of such lights was seen with the strong Hereford earthquake of Dec. 17, 1896. The earthquake occurred at 5.32 a.m. Many observers indoors saw a bright light at the time of the earthquake. There were, however, others who were out-of-doors at the time and these saw a brilliant meteor travelling northwards. The most curious feature of the observations was that the light was seen after the earthquake began in the central area, at the same time in an immediately surrounding zone, and before it at still greater distances. That is to say, the meteor crossed the country one or two seconds after the earthquake began, but travelled with such speed that, at some distance from the centre, the earthquake-waves arrived some seconds after the lights were seen[1]. Even in earthquakes of the present century, there are so many features, such as the different directions in which the lights are seen that are by no means easy to reconcile, that the German writer, Sieberg, would seem justified in describing the luminous phenomena of earthquakes as forming the darkest chapter in seismology. Until six or seven years ago, few would have dissented from Montessus' conclusion that, while not denying the possibility, we have not sufficient evidence to prove that there is any connection between the earthquakes and the lights that sometimes, but by no means always, accompany them.

Towards the close of 1930, however, a Japanese earthquake provided observations so abundant and so carefully made that we can no longer feel much doubt as to the reality of the phenomena and of their connection with the shock. This earthquake occurred at 4.3 a.m. on Nov. 26, its epicentre being near the north end of the Idu Peninsula, one that runs southward on the west side of Sagami Bay. The lights were seen by two members of the Earthquake Research Institute of Japan, one of whom, Mr. K. Musya, was so impressed that he made numerous inquiries all over and around the central area. In reply to his questions, he received nearly 1,500 accounts of the phenomena, together with many sketches of the outlines of the light. His memoir, and one by Professor Terada, based mainly on the same records, have added a new chapter, no longer the darkest, to the science of seismology[5,9].

### Auroral Streamers

As to the appearance of the lights, nearly all the varieties classified by Galli were observed. In most of them, the sky was lit up as if by sheet-lightning, and nearly all the observers agree in estimating the duration of a single flash as decidedly longer than that of lightning. At one place on the east side of Tokyo Bay, the light resembled auroral streamers diverging from a point on the horizon. Beams and columns of light were seen at different places, several observers comparing the beams to those of a searchlight. Others describe the lights as like that of fireballs. Some state that detached clouds were illuminated or that a ruddy glow was seen in the sky. At Hakona-Mati, close to the epicentre and to the north-east, a flash of light was seen, now in one spot, now in another, and, when the earthquake was at its height, a straight row of round masses of light appeared in the south-west. According to most of the observers, the colour of the light was a pale blue or white or like that of lightning, but a large number state that it was of a reddish or orange colour. The light is said to have been so bright in Tokyo that objects in a room could be seen. At another place, about 30 miles from the epicentre, it was brighter than that of moonlight.

The places at which the lights were observed lie within an area including the coast of Suruga Bay, the

Idu Peninsula, the coast of Sagami Bay, the valley of the Sagami River, and the coasts of the Boso Peninsula and of Tokyo Bay. The lights were seen to a distance of 50 miles to the east of the epicentre, nearly 70 miles to the north-east, and more than 40 miles to the west. They were seen both before, and for some time after, the earthquake, but were most conspicuous during the middle of the shock. The directions in which the lights were seen point as a rule to the neighbourhood of the epicentre, that is, to the northern part of the Idu Peninsula. The light was, however, seen in other directions, sometimes in the direction of the sea, exceptions for which it is difficult to account.

It is important to notice that, according to the Central Meteorological Office, there was no thunderstorm in the affected area at the time of the earthquake. The lights were also seen at places where there were no high voltage wires, nor has there been a single report that such wires were seen to emit considerable light. Thus, lightning and sparking from electric wires are excluded as causes the luminous phenomena, and it is difficult not to accept the conclusion of Messrs. Musya and Terada that, while we cannot as yet offer any explanation of the mechanism of the phenomena, there can be little doubt as to their connection with the earthquake.

### Earthquake "Searchlights"

During the year following the Idu earthquake, Mr. Musya studied the luminous phenomena attending four other Japanese earthquakes. The reports that he received were most numerous for the South Hyuga earthquake of Nov. 2, 1931. With this earthquake, the lights were usually described as beams radiating from a point on the horizon, as like lightning or a searchlight turned to the sky, and as of a blue or bluish colour. They were seen before the earthquake by twenty-six observers, during it by ninety-nine, and after it by twenty-two. There was no fire at the time of the earthquake in the central area, no thunderstorm, and, so far as known, not any landslides. The electric light went out, however, at three places and meteors were observed on the evening of the earthquake. Thus, some, but not all, of the lights may have been due to these two causes[6].

### Tunami or Seawaves

One more example may be given, and of a different type, for which we are also indebted to Mr. Musya, that of the luminous phenomena accompanying the seawaves of the Sanriku earthquake of 1933. The north-east coast of the Main Island of Japan is subject to the invasion of great earthquake seawaves, that are probably more frequent and more disastrous than along any other shores, and on several previous occasions curious lights have been seen with the incoming waves, while on June 15, 1896, the sea receded before the arrival of the waves and exposed a bed glowing with a bluish-white luminescence. The earthquake of 1933 occurred on Mar. 3, at 2.30 a. m., its centre being on the steep western slope of the Tuscarora Deep and about 80 miles from the shore. The luminous phenomena were seen by many observers before the arrival of the sea-waves and while the shores were inundated. As in 1896, when the sea receded before the advance of the great wave, the sea-bed gave out a bluish light. The phenomena seen with the waves themselves were of three principal types—the crest of the waves emitted a dim continuous light, the surface of the sea glittered all over, and, when the waves swept over the coast, the water along the shore-line gave out a bluish light.

### Luminescent Organisms

The origin of the phenomena that accompany earthquake seawaves seems less obscure than that of the similar phenomena with earthquakes on land. They are probably due, as Mr. Musya suggests, to the disturbance of luminescent microscopic organisms, especially *Noctiluca scintillans*, by the waves, and Professor Terada has shown that, under certain conditions, the light so emitted should be bright enough to produce such luminescence, the agitation of the water in front of the seawaves must be of quite exceptional violence, and thus that none should be seen with the ordinary seawaves along the coast[7,9].

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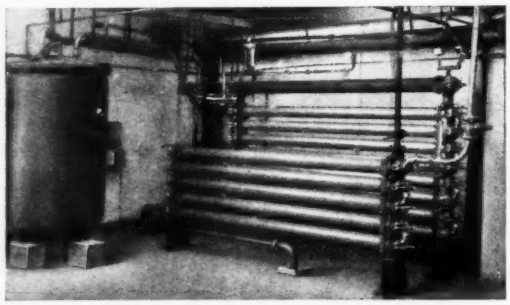
# The Science of Vinegar Brewing

**By Henry S. Sarson**

*The name of Sarson is a household one and in the following article, which is adapted from a paper read before the Quekett Microscopical Club on March 9th, the author describes how a pure malt vinegar is produced.*

WHEN I was a small boy at school a rather facetious form master, knowing well my intimate connection with the vinegar trade, said one day: "Sarson, what *is* vinegar?" To which I replied: "Something cook uses to wet the blacking, sir!" For this I received forty lines. That does, however, rather indicate the average man's attitude to vinegar. He looks upon it as something that is bought in a bottle, is used on beetroot, in mint sauce, and to pickle onions, which is about as far as he gets. He has no idea of the time, work and money involved in its production or the amount of scientific control necessary if that production is to be profitable.

Fundamentally, vinegar is any alcoholic liquor that has become soured by the action of acid-forming bacteria



*The Pasteurising unit, in which the Vinegar is heated to 170° F and cooled to 60°.*

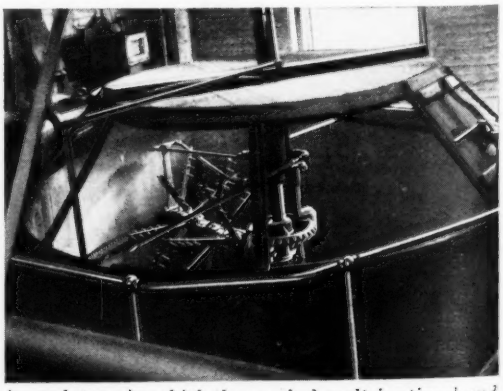
very much in the same way that milk is soured by the action of the lactic group of bacteria. The word itself comes from the old French "vin-aigre," meaning sour wine, though to-day vinegar more or less follows the national drink of the country in which it is made. Thus, in France red and white wine vinegars are the rule; in England (we are a beer-drinking nation) malt vinegar predominates, though in the cider-drinking West Country much cider vinegar is found, whilst in Scotland, the national home of whisky, 70 per cent. of the vinegar is distilled.

Our forefathers had no idea why things turned sour, the microscopist had not arrived on the scene, and their simple way of making vinegar was to stand tubs full of ale or wine in the open air and allow it to become acetified naturally. The first indication of the part bacteria played came from Pasteur and his generation of scientists, though not because they wanted to find out how to make vinegar. What they wanted was to stop wine going sour, for that had become a crucial problem for the growing export trade of the French wine industry. With this knowledge the system of manufacture was revolutionised. Vinegar brewing became an industry.

There are three stages in the modern method of vinegar brewing. The first is the conversion of starch into sugar, the second the conversion of sugar into alcohol, and the third the conversion of alcohol into acetic acid.

Starch is nature's way of providing a twenty-four hours ration for a young plant, the relationship between them being the same as that subsisting between the yolk of an egg and the chick embryo. But, because seeds are likely to be subjected to all sorts of unfavourable conditions before they get a chance to germinate, nature has invented starch, which will keep for very considerable periods without deteriorating. We have all heard of the grain found in the Tombs of the Pharaohs which, though thousands of years old, still made good bread.

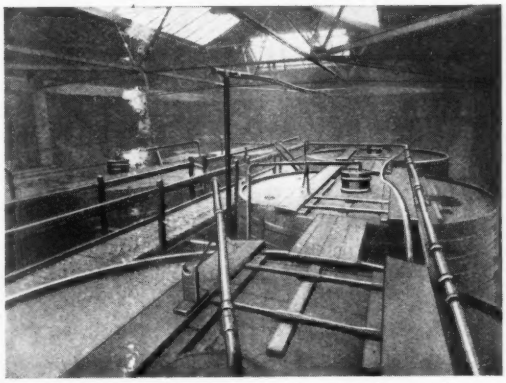
But starch, in itself, is not easily assimilated, so nature has provided young plants with a digestive system of their own which converts the starch into sugar. This digestive ability is known as diastase. It is this diastase which constitutes the difference between malted and unmalted grain, malt being any grain which has been induced to sprout by dampening and slightly



***A mash tun, in which the crushed malt is stirred and washed.***

warming. As soon as germination takes place the seedlings are killed by raising the temperature and drying off the grain, but the growth has been sufficient to develop this valuable diastatic property. Barley is the grain mostly used for malting in England and it is barley that is the foundation of beer and vinegar.

The vinegar brewer takes his malted barley and crushes it in a mill. It must not be ground into flour, but only to about the fineness of Quaker oats. He then mixes it with hot water in a large vessel called a mash tun. This is like a huge saucepan with a false bottom, which allows the liquid to drain off. It is fitted with a sparge at the top—a thing like a huge lawn-sprinkler—and revolving rakes inside. The crushed malt is alternately stirred up by the rakes and washed with hot water by the sparge. During this the diastase in the malt converts the whole



*A view of an acetifying room, showing the wooden vats in which birch twigs are packed.*

of the starch into sugar, in the form of maltose, which is dissolved by the water and drains off.

This liquid is called sweet wort and if the water is evaporated it becomes the malt extract of commerce. In the brewery, however, it is immediately cooled, yeast is added, and so we come to our second stage, fermentation.

Fermentation is brought about by a fungus—yeast. There are literally thousands of kinds of yeast, but they all have one thing in common ; in the process of growth they convert sugars into alcohol. But there is as much difference between the natural wild yeasts and the type the brewer uses as there is between a wild bison and a domestic cow, for the wild kinds produce other undesirable things such as cloudiness, ropiness and such nasty-smelling things as sulphuretted hydrogen. Therefore, the vinegar brewer has called in the help of the bacteriologist with his microscope, who now provides us with pure cultures of specially bred yeast capable of converting the maximum amount of sugar into the maximum amount of alcohol.

*The maturing vats, each containing 40,000 gallons of vinegar.*

As soon as the yeast is added to the sweet wort it starts to grow. The temperature of the liquor rises rapidly, frothing takes place owing to the large amount of carbon dioxide given off, and within forty-eight hours practically the whole of the sugar has been turned into alcohol. At this stage we call it gyle or beer, and it is, in fact, a rather poor tasting beer containing about six per cent. of alcohol. There is an interesting by-product of fermentation. The gas that is given off is carbon dioxide and it is now collected and solidified into what is known commercially as dry ice.

In the third stage, the conversion of alcohol into acetic acid, we use another organism. This is the acetic acid bacterium which caused so much trouble to the French wine growers until Pasteur discovered it. Unlike yeast, acid-forming bacteria require the presence of oxygen to live, so we build a special acetifier, a large wooden vat holding, if full, round about fifteen thousand gallons ; but we don't fill it. Inside, two floors are built about a third and two-thirds of the way down and these are covered with a layer of birch twigs about two feet deep. Below these layers holes are bored in the sides of the vat and also in the top, where there is a sparge fitted to sprinkle the gyle over the birch. The last third of the vat is filled with the gyle which is pumped over and over the birch by spraying from the sparge.

The bacteria at once start to grow, the temperature rises, and through the holes in the side and the top a draught is caused so that there is an ample supply of oxygen. By the end of seven or eight days the bacteria should have converted all the alcohol into acetic acid. Now, that sounds easy, but it isn't ! Unless there is the greatest care in controlling the temperature of the gyle and the amount of air allowed into the acetifier, great losses will occur, for both the alcohol and aldehyde (the half-way stage to acetic acid) are highly volatile, so that

an acetifier badly packed and carelessly run may lose as much as thirty per cent. of the original alcohol by evaporation; whilst if too little air is allowed, slime-forming bacteria will get the upper hand and the whole acetifier clog.

Presuming that our acetifiers have worked satisfactorily, then the rough vinegar is pumped into large storage vats to mature. Here secondary fermentations take place and the vinegar develops its characteristic aroma and flavour. This process takes about six months, and not until then is the vinegar fit for clarifying and pasteurising and, finally, filling into casks and bottles for the market. We see, therefore, that the whole process takes about nine months and during that time and at each stage the manufacture has to be most carefully watched to avoid trouble.

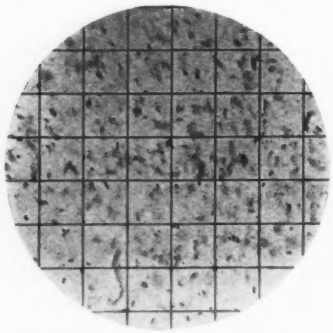
For the microscopist vinegar is an interesting study. It is, or should be, entirely a product of bacterial action, and not only are the organisms themselves interesting, but they have hosts of wild cousins who, as parasites, are a constant source of trouble to the brewer. For instance, infection of sweet wort by any of the lactic bacilli will immediately inhibit the action of the pure culture yeast. Mycoderma and wild yeasts of the pastorianus and elipsoideus types will, especially in cask vinegar, turn it cloudy and bad smelling.

" Mother " of vinegar, that jelly-like mass often seen in a bottle, is the vinegar bacterium itself, of a type known as xylinum. The bacteria will also continue to grow after they have turned the alcohol into acid, and finally convert the acid into carbon dioxide and water, unless air is excluded and the vinegar carefully filtered and pasteurised. I should like to point out here that because vinegar is used in the preservation of vegetables, fish, etc., the public imagines it will preserve itself. This is wrong. Vinegar is not a disinfectant. Like its two great allies, salt and sugar, it will pickle all sorts of foods, but, also like salt and sugar, unless properly kept it will " go off " itself.

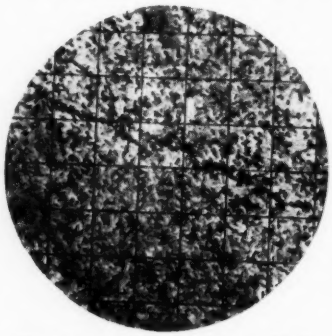
There is a type of cockroach found in vinegar breweries, at least two kinds of vinegar fly, and last, but not least, our old friend the vinegar eel. This creature, *Turbatrix aceti*, originated in the slime fluxes of beech and oak trees and was probably introduced into the vinegar trade by the use of these woods in the breweries. If it gets control of an acetifier it can completely stop it working, as it destroys the acetic bacterium itself. Luckily this control is comparatively simple, so that no vinegar brewer who knows his job would ever have trouble with eels.

Now for some practical points. There have been many arguments over the relative merits of sacks, shavings, and birch as an acetifying medium, but birch twigs have been found the most efficient because they are fairly strong, and the space in between allows a very good flow of air; however in using birch twigs considerable care has to be taken in packing them. Another form of acetifier contains raschig rings; these are little porcelain rings of French origin, which are very effective, though their great weight is a disadvantage. Birch has become almost the universal medium now for malt vinegar brewing, but in spirit breweries beech is used. The twigs can be used again, but it is unprofitable to do so; they do not impart any particular flavour to the vinegar but merely serve as the " home " for the bacteria and thus present the maximum acetifying surface to the maximum liquor surface, which latter is obtained by restricting the vinegar in drops and letting it slowly over the twigs.

Sulphuric acid used to be used intensively in vinegar, so much so that a Commission was appointed about 1850 which created quite a stir. About eighteen months ago I received a copy of the *Lancet* for that time giving the analyses, and they found that a great many vinegars

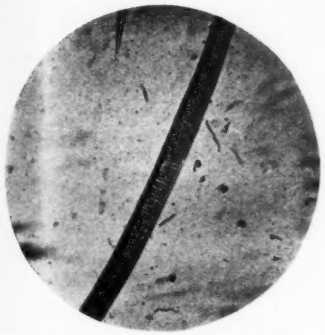


*Bacterium Aceti—primary infection. Magnification 250.*



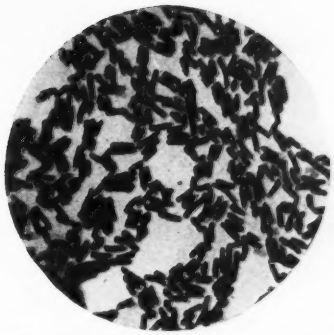
*The same after 7 days at 98° F. " Mother " starting to form. Magnification 250.*

*Turbatrix Aceti—vinegar eels—male and female. The male is very much smaller than the female. Magnification 100.*



*Female eel highly magnified showing embryos. Magnification 350.*

*Oidium infection from vinegar ullage. Magnification 250.*



*The same after incubation on malt agar. Magnification 375*

were of high acidity due to the excess of sulphuric acid added, and as a result of this the law prohibiting the use of sulphuric acid was passed. When preparing the casks for the vinegar they are sometimes washed out with bisulphide of lime, which is quite harmless, but if the Public Analyst finds a trace of this remaining the vinegar brewer is penalised. There is no sulphuric acid in vinegar to-day.

There are various ways in which the growth of parasites is checked; for instance, if microscopical examination during the fermentation process reveals the presence of lactic acid, the only way to eradicate it is to put in more yeast and complete the fermentation as quickly as possible. Vinegar eels are destroyed by heat. In one case, however, heating of an infected vat was ineffectual. It was subsequently found that this was due to the eels having lodged in deep cracks in the wood, and in heating the vinegar the temperature did not get down to these little cracks. To meet this contingency experiments were made, first with sodium hydroxide, then with ammonia, which latter was effective, so that infected vats are now cleaned out, the cracks filled and the vats filled with ammonia and allowed to stand for twenty-four hours.

At the present time kieselguhr (diatomaceous earth) is much used in the filtration of the vinegar. Each press is washed after a few hours' running when from 4,000 to 6,000 gallons of vinegar have been filtered. The press is then dismantled and the linen sheets through which the vinegar is pumped are washed clean of the kieselguhr and the press is then reassembled and precoated with fresh kieselguhr. This precoating is done from a small vat in which the earth is mixed with vinegar and pumped through the press again and again until a perfect filter-bed is formed, then the pumps are switched over and the vinegar to be filtered passed through. When the vinegar ceases to run because the press is clogged it is shut down and the process above described repeated. Usually this happens two or three times a day.

It will be apparent from these details that vinegar brewing is by no means an automatic process, and contains complications of which the ordinary consumer is completely unaware.

## Dufaycolor for the Photo-Micrographist

Dufaycolor film opens up an entirely new field in photomicrography. Many have experienced the delight of gazing down the tube of the microscope at the marvellous colours resulting from viewing subjects under polarized light. It has long been the desire of microscopists that these transient colours should be photographed and permanently recorded and Dufaycolor enables this to be done. The whole range of colour is recorded. It is not necessary to differentiate any particular chemical salts which may give a richer rendering than another, but coumerin, isatine, banalline, magnesium plantiocyanide are just a few amongst hundreds.

The examination of rock sections under crossed nicols and the angles of extinction of the crystal so examined are routine work, but the recording of the colour graded in what is known as the Newton scale has been inpossible until the arrival of colour film. It is now possible to take a small section of any rock and examine it with the nicols open at an angle of 45 deg. and also under crossed nicols, and thus a complete record of the colour variation and the angles of extinction can be permanently obtained with all the necessary colour renderings.

In the histological and botanical fields, sections cut and stained may be photographed with the Dufaycolor process and exact photographs of the stains differentiating the various tissues are faithfully recorded. It is obvious how valuable the photographic record of such subjects may be in future in the general educational world, and particularly in the case of lectures given at colleges and similar institutions.

Dufaycolor film may equally well be used for recording experiments in light which have hitherto had the handicap of merely being photographed in monochrome. Such a subject as the photography of spectra in colour opens up an immense field, and it should not be long before there are standardised photographs of spectra of the elements in colour.

# Distilled Water Without Heat

**By H. Courtney Bryson.**

*The first account in a popular journal of an important development which makes "conductivity water" available in large quantities.*

It is now common knowledge that carbolic acid reacts under heat with formalin to produce an artificial resin, called Bakelite resin after one of the original discoverers, Dr. Baekelund, and that this resin mixed with an equal weight of wood flour and heated in dies under pressure produces the enormous varieties of moulded articles sold all over the world for almost every conceivable purpose. The resin under the combined action of heat and pressure becomes infusible and insoluble in all solvents. The number of patents on modifications of this reaction runs into thousands. It is further known that by modifying the carbolic chemically, synthetic resins can be produced which have properties differing from the simple phenol-formaldehyde type. Thus by having two instead of one hydroxy group in the carbolic molecule, resins can be made which are used to impregnate paper and make the single-sided, long-playing, unbreakable durium-type records so popular a few years ago. It is on this type of polyhydric phenol resin that a further and much more startling discovery has now been made by two research workers at the N.P.L. Chemical Laboratory at Teddington.

### Wide Industrial Application

In brief, they have discovered that resins which are completely insoluble in water—more insoluble than glass, for instance—can yet extract all dissolved solids contained in the water and even kill dangerous micro-organisms. This is easily one of the outstanding discoveries of this decade, for it affects every industry using water—and few industries do not use water. The textile industry, the chemical industry, the paper industries, and all those concerned with the production of energy in the form of steam or electricity are vitally affected. It is popularly supposed that most really great discoveries spring from an accident. This is seldom, if ever, the case. The mechanism of discoveries of this nature generally springs from an accidental observation of a phenomenon followed by acute reasoning and long experiment. This was the actual procedure in this case.

It was known that certain peats sometimes extracted constituents from stream or bog water, and it was further observed that some of the bakelite type resins darkened in contact with strong alkalies and appeared inclined to dissolve. Working on this slender basis, many thousand experiments were carefully and patiently carried out over a period of years testing almost every known and many unknown resins. Now it must be explained that chemically pure water consisting of nothing else but molecules of $H_2O$ is extremely difficult to prepare (iridio-platinum apparatus is necessary) and therefore rare and costly. By far the greatest majority of chemists and physicists have never seen or handled "conductivity water"—so called, we believe without irony, because it is one of the most perfect electrically insulating media known. The faintest trace of impurity increases its conductivity enormously.

### Water Impurities

The usual impurities in tap water besides dissolved gases and micro-organisms are the sulphates and carbonates of calcium and magnesium. These constitute the hardness of water. On heating, their solubility decreases and they are deposited as a fur, which ruins boilers and wastes coal. On addition of soap (sodium stearate) insoluble calcium stearate is thrown out as a greasy grey scum which sticks to the baths and basins, and ruins the white colour of fabrics. Water is softened in the normal way by the addition of a substance like soda which precipitates out the calcium and substitutes the sodium salt which has no violently harmful properties.

Now it has been discovered by Adams & Holmes, the two research workers mentioned, that by the mere passage of water through certain powdered resins, the calcium and similar metallic ions are completely removed. If the water were previously neutral, it is now acid, as what might be termed the neutralising base (metal) is absent. By the further passage of the same water through another type of synthetic resin the whole of the acidic ions (sulphates, chlorides, etc.) are removed and the water is then neutral and pure. It is thus possible to produce distilled sterile water in the cold, of a purity easily comparable with the best distilled water obtainable, and very much cheaper since no heat and no condensing apparatus is required. An experiment was carried out showing that in addition this type of resin has germicidal properties. One gram of washed resorcinal resin was added to 10 cc. of a suspension of 250 million *B. coli communis*. At the end of two hours all the organisms were destroyed.

The exact mechanism by which the impurities are extracted is not understood. No part of the resin goes into compensatory solution. It is probable that a loose molecular adhesion occurs on the surface of the resin. Different synthetic resins extract different amounts of metal ions or acidic ions from water before they become saturated, and cease to work. They may then be easily regenerated by pouring through a dilute solution of an acid in the case of the first resin and an alkali in the case of the second. This treatment dissolves the metal and the acid from the surface of the respective resins. The resins are slightly improved by constant working. They never wear out. The resin which gives the greatest capacity in the removal of metallic ions from water is easily prepared by treating one of the cheapest of tannins, quebracho tannin, with formalin in the presence of an acid or basic catalyst to facilitate the reaction. Equal parts of tannin and 40 per cent. formaldehyde are taken and 10 per cent. of catalyst (hydrochloric acid) added and the whole warmed. A gel separates which dries to a dark, hard mass on breaking up roughly and heating to 120° C. The resin is then readily ground up, a convenient size being about forty mesh. Before use the resin must be washed with dilute acid and distilled water. When water containing calcium and magnesium sulphates—the principal constituents of hard water—is then treated, the metal ions (calcium and magnesium in this case) are absorbed by the resin so that the resulting effluents become acid.

### The Action of the Resin

This is not of great practical value since the effluents would be too acid for ordinary purposes. But the important fact is that when a strong solution of a sodium compound such as common salt is put through the bed a calcium-sodium exchange takes place so that sodium is substituted for calcium in the water. The resin thus regenerated has the property of softening hard water by depositing calcium on the resin. It is then ready for use. For the removal of acidic constituents easily the best substance is metaphenylenediamine condensed with an equal weight of formaldehyde. The metaphenylenediamine is dissolved to give a 25 per cent. solution in water and 40 per cent. formalin is added. The reaction is very vigorous and much heat is liberated as the whole mass sets to a solid infusible block. This is ground up in a similar way and washed. The granules are then packed into glass tubes, 2 cm. in diameter, containing a small plug of glass wool at the bottom. Water is allowed to drip slowly through the tubes (200 cc. per hour)

In general 10 gm. of the first resin will remove 84 mgm. of calcium or its equivalent in magnesium per gram of resin from the water and the second 71,400 mgm. of sulphuric acid or its equivalent of another acid radicle per gram of resin. When it is suspected that this capacity is about reached, a few drops of the liquid issuing from the first tube should be tested by the addition of a few drops of dilute oxalic acid. A faint cloudiness indicates that the capacity of the resin has been reached. The second tube is tested in exactly the same manner but employing silver nitrate instead of oxalic acid. Regeneration is best achieved by pouring slowly through the tubes dilute hydrochloric acid in the first case and dilute caustic soda in the second. Though they are protected by patents, anyone can make these resins for his own use and prepare his own distilled water. At present distilled water costs 2s. 6d. a gallon. It can be made by this process for 3d. a gallon. There is therefore a nice little business waiting for anyone who likes to undertake the supply of distilled water to wireless shops and garages. At the present moment vast world-wide plans are in process of fructification for the utilisation of this discovery. Large plants are being erected for the turning of this laboratory process into one capable of dealing with millions and millions of gallons of water. The old plan for extraction of gold from sea water now becomes something more than a chimera. Saline waters from inland seas far from fresh water can now be employed for feeding locomotives and for similar purposes. Drinking water for use on board ship can be prepared from sea water—though it naturally possesses the flat and insipid taste of distilled water. Sewage can be purified. Obnoxious trade effluents can be economically dealt with. It will probably now be possible by modifying the resin slightly, easily to extract certain substances, *e.g.*, radium, present in minute amount in vast masses of useless matter.

These resins are but one more milestone on the road leading towards the transition from the metal age to the synthetic plastic age.

## Noise Measurement

Last month, the first international conference on acoustics met in Paris under the auspices of the International Electrotechnical Commission. While substantial progress and agreement were reached in all the committees, chief interest centred in the questions of fundamental units and methods of measurement, and it is gratifying to learn that the proposals eventually adopted agree in their entirety with the British Standards as given in the British glossary. Thanks in particular to the conciliatory attitude of the delegates of Germany and the United States the " phon " and the " decibel " become international units and thus a valuable and important contribution to international acoustical measurements has been achieved.

# Early Culture at Chanhu-daro

*The discovery of a new phase of Indian history with considerable cultural connections is the result of the recent work of America's first archæological expedition to India, as reported by Dr. Ernest Mackay, Field Director of the Expedition. The Expedition was a joint enterprise at the site of Chanhu-daro in the Indus Valley of the American School of Indic and Iranian Studies and the Boston Museum of Fine Arts.*

THE mounds of Chanhu-daro were selected for the preliminary investigations of the first American archæological expedition to India on account of important finds made there during a survey of the ancient sites of Sind by the Archæological Department of the Government of India in the winter season 1929-30. Mr. N. G. Majumdar, who dug three trial trenches there, showed that Chanhu-daro had been occupied by the same race that built the cities of Mohenjo-daro and Harappa some five thousand years ago. He also found some slight evidence of the presence of a later civilisation which can now be named the "Jhukar culture," in accordance with the convenient practice in Egypt and Mesopotamia of naming a culture after the site where traces of it were first found. The so-called "Indus Valley civilisation" should be re-named the "Harappa culture," for further excavations in the great river valley will undoubtedly reveal the remains of yet other ancient cultures.

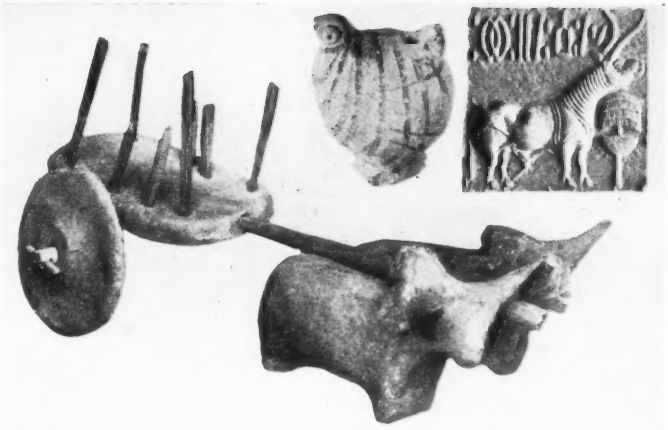
Chanhu-daro is some twelve miles east of the present bed of the Indus, about eighty miles S.S.E. of Mohenjo-daro. Its three mounds comprise an area of nine acres, but the little city was considerably more extensive in ancient times and the alluvium deposited in the course of five thousand years or more now covers the lower parts of the mounds. Mound I is 22.2 ft. high, and some 1,500 square feet in area, and the rather larger Mound II, 23.5 ft. high and about 3,850 square feet in extent, is separated from it to the N.E. by a gap some 150 ft. wide. During the period of the Harappa culture, Mounds I and II were one, and through this a devastating flood ultimately cut its way, bringing to a close the longest and most important chapter of the history of the little city. Mound II was reoccupied later for two brief periods, as we shall shortly see. The third mound, which stands a few feet high and is only some 500 square feet in extent, lies close to the N.W. of Mound II, of which it is certain that it once formed a part; the rainstorms which have separated this little mound from its neighbour have left their marks as deep furrows and ravines which scar the sides of all three mounds.

As Mound II was the largest and highest mound and therefore likely to contain the most interesting material, it was selected for the principal excavations. Its upper portion was systematically removed, layer by layer, the débris being dumped on ground that had already been examined by means of trenching. On the summit of the mound were one or two graves of early Mohammedan date. Below these very late remains, a few pieces were found, mostly intact, of a very interesting dark grey, polished, hand-made ware with incised geometric decoration. The exact date of this ware is at present a matter of surmise, but in shape and technique it is entirely different from anything produced by the two cultures whose remains we found beneath it. This grey, hand-made pottery was probably made by a primitive people who were the last to occupy the site—and that only very briefly and in small numbers—and who may have been a race allied to the Bhils, of whom there is a settlement close to Chanhu-daro; these Bhils, however, have lost most of their ancient customs and primitive way of living.

*The pavement of a bathroom at Chanhu-daro with the bath platform edged with bricks.*

In the stratum below this grey ware the searchers came upon a large quantity of wheel-made pottery, quite unlike the wares found either above or below it. This pottery, which was mostly polychrome, with devices painted in black and red on a cream or pink slip, is represented mainly by broken frag-

ments of the pans and stems of offering-stands, though pieces of other types of vessels also were found. Though polychrome pottery was made at the latter end of the Harappa period, the polychrome ware of the upper levels of Chanhu-daro in nowise resembles it in shape or style of decoration. Its presence in considerable quantities therefore marks the occupation of the site by a different people. At Jhukar also it was in a stratum that showed it to be of later date than the Harappa culture. A principal feature of this Jhukar ware is that broad horizontal bands of red separate the various devices that ornament it. Red was also used in combination with black for certain motifs, a common one being a chevron pattern of red and black alternately. The designs on the Jhukar pottery are either geometric or very conventionalised, boldly painted plant designs of leaves or buds joined together with curved stems. As a rule these plant designs were painted in black, or a deep purple, the red being used for the broad bands separating the registers, but occasionally the interiors of the buds or leaves, if not hatched, were coloured red.



*Some interesting articles from Chanhu-daro : a toy clay cart drawn by two humped oxen ; a whistle in the shape of a hen ; and a seal amulet with urus-ox and cult object.*

There is a considerable body of evidence that the people of this Jhukar culture occupied the principal mound at Chanhu-daro comparatively soon after its desertion by the people of the Harappa culture, about 200 B.C. It was only a small settlement and, judging from the number of rough pavements and fireplaces found, the people lived in houses of matting, all other traces of which had disappeared. The headman had a plain, roughly built house of bricks, taken either from the lower part of the mound or from other buildings of the Harappa culture in the vicinity. One very interesting feature in a room of his house was a fireplace in a recess in the wall with three bricks still in it which served to support a cooking vessel.

Not only does their pottery, of which a surprising amount was made and used, distinguish these people from their predecessors of the Harappa culture. They wore seal-amulets, mostly pottery, which in their shapes and ornamentation are totally unlike the square and rectangular seal-amulets of the Harappa culture. Some are round stamp seals with roughly shaped perforated handles at the back, and others lentoid with designs on both faces and perforated laterally. These Jhukar amulets are with one or two exceptions very roughly made, and none bears any inscription : in fact, it is as yet uncertain whether their owners knew how to write. Many of them resemble certain seal-amulets of early Elamite date, and one exceptionally well made lentoid amulet with an endless rope pattern on one side recalls both in shape and the design certain Hittite seals ; which is the less surprising when we consider the marked affinities of the pottery with the late ware of Tell Halaf.

A number of bone awls polished by much use suggest that the Jhukar people made baskets, and judging from the number of bobbin-shaped objects that they left they seem also to have been workers in textiles. The figurines of the Harappa levels tell us that the head-dresses of that period were very elaborate, and this appears to have been the case in the Jhukar period also ; a very fine head-rest of painted pottery was undoubtedly intended to protect the head-dress of its owner from damage during sleep.

Close beneath the Jhukar stratum the party came upon buildings of the Harappa culture at a level approximately thirteen feet below the summit of the mound. Here were found the remains of burnt brick houses with the bath-rooms, drains, and other conveniences now well known at Mohenjo-daro and Harappa. Here, too, were found the copper and bronze implements and tools that now form an important part of the collection in the Museum, blade-axes, chisels, spear-heads, and copper and bronze vessels of various shapes, which all go to show that Chanhu-daro was a great centre of metal working ; but whether bronze or copper was the metal more commonly worked can only be ascertained by analysis of the material obtained. Important evidence of metallurgical practice was the number of small masses of lead that were found, evidently the remains of some considerable working in this metal.

No skeletal remains of either the Jhukar people or Harappa people were found, save a skull that had

been placed in a large storage jar together with a small collection of metal objects and a large conch shell. Some care must have been exercised in inserting this skull in the jar, whose opening was barely wide enough to receive it; and why the skull only was thus carefully preserved and not the other bones is a matter for speculation. Bead-making was practised even more extensively at Chanhu-daro than metal working. The long agate and carnelian beads of barrel-cylinder shape, of which so many fine specimens were found at Mohenjo-daro, were quite possibly made at Chanhu-daro; for large numbers of them were unearthed in all the various stages of making. The long rectangular slips of stone struck from the parent nodule were first flaked roughly into shape, then after careful chipping to remove the angles they were ground into the required cylindrical form by rubbing on a piece of sandstone, which became deeply grooved in consequence. The beads were bored from both ends with a stone drill, and they finally received a polish that shows the craftsmen of Chanhu-daro to have had long experience in the art of working hard stones. The stone drills that were used, of which a number were found, both whole and broken, are a new discovery: it has hitherto been supposed that in ancient times stone beads were bored by means of a copper drill with the aid of an abrasive.

### Beadmaking Skill

Beads were also made of softer materials such as steatite; a number of tubular shape, stuck together by the salty soil and evidently once contained in a fine basket which had perished, would if placed together, end to end, run to 35-40 to the inch. How they were shaped and, even more, how they were bored is at present quite incomprehensible. Save in their extraordinarily skilful bead-making and also in the manufacture of weights—a subsidiary industry—the people of Chanhu-daro made little use of stone for other purposes. Copper was evidently so plentiful that stone implements had already been practically discarded.

Stone was occasionally used for mace-heads, both of globular and lentoid shape, for drill-caps, and even for dishes; the latter, however, were both few in number and very clumsily made. They were, moreover, sometimes made of a soft form of alabaster, a stone which does not withstand corrosion by salt. A large number of rectangular stone palettes with smooth level surfaces were found, but the great majority were broken. They were probably used for preparing cosmetics and may have been placed on the small, roughly made pottery toilet tables with four short legs, which also were rarely found intact.

A remarkable number of toys were found at Chanhu-daro, far too many, it would appear, to have supplied the wants of the child population there; it is possible that toy-making also was a local industry. Toy vehicles of various shapes made of pottery, mounted on two or four wheels and drawn by a pair of humped oxen as in modern Sind, form an interesting feature. Pottery model rams, with the fleece indicated by lines of red paint and mounted on two wheels with a hole through the neck for a draw-string, were common playthings. Marbles of pottery and stone, whistles ovoid or shaped like hens, and brightly coloured rattles for the younger children were abundant.

A number of pottery figurines were found of the Mother-goddess, who was also worshipped at other centres of the Harappa culture. Some of these figurines wear a curious fan-shaped head-dress ornamented with bands of material, unless it is strands of hair that are represented, carried over a support of some kind. The nose was simply pinched up by finger and thumb, and in the depressions thus formed pellets of clay were set to represent the eyes. Possibly there was one of these little figures in every house in a niche in the wall; and with them there seem to have been associated the little model doves with outstretched wings, each with a hole in the base to set it on a wooden pin. The dove was intimately connected with the worship of the Mother-goddess in ancient Crete, Sardinia, Mesopotamia, and elsewhere, and it seems likely that it was in the Indus valley also.

The seals were all made of steatite. In shape, material, and the animals engraved upon them, they are identical with those found at Mohenjo-daro and Harappa, and many of them were similarly given a smooth white surface to enhance their appearance. The animal most often represented on these seal-amulets is an ox-like beast, always in profile with a single horn. This creature has been identified with the urus-ox, a beast which is extinct in most parts of the world. Before it there is always placed a curious upright object, which on the better carved seals is seen to have been made of wickerwork. What this object really was is as yet uncertain. It has been identified as a fodder-rack, a cage for a bird, and an altar. That it was a cult-object is, however, certain, for at Mohenjo-daro and Harappa amulets have been found on which this object is carried on a staff in what was obviously a religious procession. This ox-like animal with its cult object is much the most common device on the seals of the Harappa culture, but there are other animals also on the seals.

Certain small pottery vessels, all very much the same size and shape, seem to have been supplied by shop-keepers to purchasers of small quantities of cooking-oil and the like, as at the present day. Other small jars

with extraordinarily narrow mouths once contained an eye-paint, which cosmetic was apparently used by men and women alike. Of particular importance is the bronze cosmetic jar with fluted sides, which is a notable feature of the Museum collection. Here might be mentioned a rectangular slip of red ochre with a bevelled end, whose shape makes it more than likely that it was used as a face paint, if not actually as lipstick. The small cones of pottery or shell which were found in the Harappa levels at Chanhu-daro are somewhat of an enigma. Very similar cones served an architectural purpose at Warka, Ur, and other early Sumerian sites, but insufficient numbers have been found at the Indian sites to warrant the assumption that they were put to a like use. They may have been cult objects, or even skittles to be knocked over with marbles.

A large number of chert weights, carefully made and polished, were found. They are nearly always cubical, and they belong to a definite system, with the simple ratios 1, 2, 4, 8, etc. In weight they vary remarkably little from those found at Mohenjo-daro, and similar weights from Harappa, more than four hundred miles N.E. of Chanhu-daro, have the same actual weights according to their respective sizes.

In the uppermost level of the Harappa culture there were but few intact buildings, though relics of houses and an extensive drainage system were found in this stratum all over Mound II. The occupation level below was in a better state of preservation, and streets and lanes, each with its houses and drains, were more or less intact and could be satisfactorily planned. Remains of a still earlier occupation were revealed in the upper part of a large cutting that was made in the western side of the mound to test the strata below, and at still lower levels were found traces of other occupations until the sub-soil water prohibited any further digging. One very striking feature of these occupation levels in Mound II was that each was separated from those below and above by a considerable lapse of time. At Mohenjo-daro one occupation followed on another in swift succession, the later builders simply using the walls of their predecessors as foundations, thus preserving the alignment of the streets and houses over a very long period. At Chanhu-daro quite a considerable amount of débris separated the two uppermost Harappa occupations, and the buildings in the stratum next below these two were orientated quite differently from those above them.

The bricks used at Chanhu-daro were very much the same size as those of the other Indus cities; they average 11 × 5½ × 2½ inches. Made of well-fired clay, they are well-shaped but have no frogging of any kind. The mud mortar used amply served its purpose. They were laid to dry as they were shaped in open moulds, and occasionally one is found with the impress of an animal's foot. For special purposes, such as lining wells, wedge-shaped bricks were made, and angle-bricks and half-sized bricks have been found. Bricks were also cut into various forms after being laid, as in the recesses of water-chutes; and those forming the corners at the junctions of drainage channels were often carefully rounded off with a chisel so as to impede the flow of water as little as possible. Most of the drains were made of ordinary bricks, and they were laid only a few inches below the surface of the ground so that they might be got at easily for cleaning. Owing to the demolition of many of the houses for the sake of their bricks, whenever the site was deserted, few of the bathrooms were found intact. Those few were simple platforms of carefully laid bricks, edged all round to a height of some two inches with bricks laid on edge; the water flowed away through an opening that sometimes communicated with a latrine situated between the bath and the street wall, and thence through an aperture in which the effluents passed to the street drain outside. There is no doubt that the sanitary system of the ancient Indus cities surpassed any other of contemporary date, and it is quite safe to say that it was superior to that in many modern oriental cities, which civilisation seems barely to touch.

## Pre-Palæolithic Palestine

Among the antiquities from Palestine included in the exhibition of the Wellcome Marston Archæological Research Expedition to the Near East for the season 1936-7 (*see* DISCOVERY, August, p. 249), were a number of pre-palæolithic implements, or eoliths, from Bethlehem which, unfortunately, were not available for the exhibition until it had been open for some days, and, consequently, could not be recorded in our earlier report.

These implements, which were selected *in situ* from a much larger number as most typical by Miss G. Caton-Thompson, are derived from an excavation now known as the Bethlehem Bone Beds, which has been under examination for several seasons by Miss E. Gardner, geologist, and Miss D. Bate, palæontologist, of the British Museum (Natural History). It is a pit, apparently a swallow-hole, filled with clays and gravels in which are the fossilised remains of mammals. Here in 1934 was found the first evidence of the existence of the elephant in Palestine.

Among the fossils found in the course of a brief season's work in 1937, and now shown, was the rear portion of the carapace of a gigantic tortoise. Five detached plates and a limb bone were found nearby.

# Silver for Perfumes

**By C. C. Downie.**

*A little-known use of silver, thanks to its non-corrosive qualities, is for the transference of a perfume, or other volatilised liquid, to materials which must not be discoloured*

SILVER cannot be expected to compete in every respect with the much less costly base metals as a means of resisting corrosion, but its high thermal conductivity is not likely to meet with the same competition. Pure silver possesses the greatest heat conductivity of all metals, details of which are to be had from the works of Regnault, Bunsen, Schenck, and others. Despite this outstanding physical property, it is doubtful whether much commercial application has been made of it until quite recently. The heat conductivity of alloys is never so high as that calculated from the conductivities of the component metals, and only in a few exceptional cases is it the same. Practically whatever addition is made to the silver, the thermal conductivity is reduced, and hence there is little option but to use pure silver in order to secure the best results.

Probably most silver on the market is refined electrolytically, which ensures absolute purity, and accordingly is best suited for conduction purposes. Like other metals, silver, when made into pipes or otherwise rolled or hammered, conducts better than when cast. Thermal conductivity is seen to best advantage where low-temperature work is required, since, as the temperature increases, the conductivity decreases.

Strange though it may appear, comparatively little commercial advantage has been taken of this property of silver, partly owing to the high market price, but largely because of the secrecy observed by certain chemical manufacturers. In order to maintain this privacy, the silver is procured from one firm, and transferred to another for converting to pipes, and the former, although perhaps better equipped, do not know for what purpose their silver has been used.

Comparatively few industries can claim such wide expansion of recent years as the manufacture of perfumes, thanks to the popularity of fragrant products throughout the world, and there appears to be an ever-increasing demand. Formerly the perfumes themselves were distributed, but to-day all kinds of goods are placed on the market in perfumed condition. This condition can be attained quite inexpensively by volatilising the fragrance so that it will be absorbed by the goods, since a very minute proportion suffices to make the presence of the perfume apparent. Instead of applying some cheap perfume, the best essential oils can be volatilised at little cost, and as these have been subjected to the proper fixation, they show but little disposition to dissipate readily. Perfumed cards, which were originally used as a means of advertising the particular fragrance used, are to-day employed for innumerable advertising purposes, and are all prepared by the volatilising system. Leather, furs, feathers, cloth, and innumerable other fabrics are subjected to the same process.

In order to secure the best results, the prepared perfume is gently heated in a tubular heating system and condenses on the goods. Copper pipes, which were at first used, although only corroding but slightly, tended to pass a faint tint of colour on to the goods, and nickel, because of its low thermal conductivity, could not be considered. This led to the adoption of silver pipes which, although more expensive, proved most satisfactory, and could be used for the perfuming of all classes of goods. Similarly, silver pipes and sprays have been recently tried for disinfection purposes. The heating system of disinfecting books from lending libraries occupies too long, apart from an extensive outlay on plant. Since formalin became popular, all kinds of other reagents have been substituted to ensure rapid disinfection, and the silver pipe conducts the heat for the short length to the sprays. The manner in which the leaves open to receive the disinfectant has been dealt with elsewhere, and need not be described here. The point of importance to note is that no discoloration can be tolerated, particularly with the leaves of expensive works, and this gave rise to following the methods of the modern perfumer. It must be admitted that this use for silver has as yet been a small one, but further applications could be made on the same lines.

## The Aryan Atom

The distinction drawn between Aryan and non-Aryan under the National Socialist régime in Germany has produced absurd, as well as painful incidents. Among the former the palm, perhaps, must be awarded to a comment in a recent lecture in the University of Berlin reported in the *Berliner Tagebatt*. Professor Stark, Director of the Physico-Technical Institute, severely criticised the atomic theories of Lord Rutherford and Dr. Niels Bohr on the ground that they had adopted the view of the atom taken by Jewish physicists. The Aryan atom, Prof. Stark is reported to have said, is quite different from the Jewish atom. As the foremost physicists of Germany were Jews or of Jewish extraction, this is probably quite correct, but does not carry conviction as to the sanity of the judgment it expresses.

# Book Reviews

## New Exploration in the Middle East

*Archæological Reconnaissances in North-West India and South-Eastern Iran.* By SIR AUREL STEIN. (Macmillan, 63*s*.)

In 1931 Sir Aurel Stein, unable to continue his explorations in Central Asia, determined to direct his activities to investigation in Iran of regions previously inadequately studied topographically and archæologically unexplored. While awaiting completion of the arrangements for his start, Sir Aurel carried out two expeditions in north-west India. His main object was to round off his researches on the invasion of India by Alexander the Great by determining the exact limit reached by the Macedonian forces—the point at which Alexander set up the "twelve altars"—and the site of the battle in which Poros was defeated on the banks of the river Hydaspes (the Jhelum). The exact site of the battle between Alexander and Poros has been the subject of much discussion without agreement having been reached. Sir Aurel by a closer examination of the literary authorities on the actual ground of the various localities which have been suggested, demolishes the views of previous investigators by detailed topographical and tactical argument; but he arrives finally at the conclusion that it is improbable that the exact site will ever be determined.

In the following autumn Sir Aurel returned to Kerman, his objective for the season 1932-3 being to explore the coast of the Persian Gulf for prehistoric and early historic sites. Though the full programme planned was not carried out, as the Persian authorities forbade further exploration owing to tribal unrest, over 2,400 miles were covered in two journeys. The country explored in 1931-3 and the regions which Sir Aurel has since investigated have a double importance for the student of prehistoric civilisation. In the geographical sense, with the regions in British Baluchistan and Makran explored by Sir Aurel in 1926 and 1927, they form a continuous link between the regions of the prehistoric civilisation of the Indus valley and those of Susiana and Mesopotamia. Archæologically, so far at least as concerns this early civilisation, they were a blank, except for one or two isolated sites; and the existence of a prehistoric culture in this area was a matter of inference rather than of assured fact. Sir Aurel has now recorded a large number of sites, burial and other, on which by surface finds and by trial excavation, he has established the existence in Southern Persia of a chalcolithic civilisation, which is to be linked with the neighbouring cultures of the 4th and 3rd millennia B.C.

As the author explains, the extent of the ground to be covered, and the limits of time imposed by his age—but not his vigour, which remains unimpaired—made it imperative that these investigations should be no more than a reconnaissance. If the narrative misses in its mass of detailed observations something of the binding spell of which the author has shown himself a master in his narratives, it must be attributed to this same exigency. Sir Aurel has opened up a vast field, from which, in the magnificent series of plates illustrating the ceramic finds, we may all reap a profit. E. N. FALLAIZE.

## A Russian Savant

*Pavlov and His School.* By PROFESSOR Y. P. FROLOV. (Kegan Paul. 12*s*. 6*d*.)

This is a popular account of the physiological researches of Pavlov and his pupils on conditioned reflexes. It is very clear and readable, and is enlivened by descriptions of actual experiments and of the life of the workers in the laboratory. A distinct impression of the attractive and dominating personality of Pavlov himself emerges. The only fault in exposition is that some of the diagrams are startling rather than instructive.

Simply as an account of Pavlov's own views and of his later work, the book is excellent; but the author shows very little appreciation of anything done outside, whether in the sphere of the physiology of the nervous system or of psychology. Sherrington's work is mentioned, but not (I think) understood. Kohler's work on the behaviour of apes is very unfairly treated. Pavlov may say that a dog has "hunger reactions" or "defence reactions" and he is praised for being scientific and objective, though hunger and defence are entities unknown to physical science. Kohler must not speak of an ape "grasping a situation as a whole," or having "insight into a problem"; that is "subjective" and, therefore, taboo.

Pavlov devised a very powerful experimental method, but he planned his experiments and described his results in terms of rather crude and imperfectly analysed concepts, which were, however, useful as far as they went. His enthusiastic pupils are convinced that these concepts are perfect and of universal application and find, moreover, that they can be hallowed by incorporation in the canon of Marxian orthodoxy. Pavlov's classical work on digestion is, unfortunately, dismissed in a couple of sentences. A. D. RITCHIE.

## Land and the Landscape

*The Scenic Heritage of England and Wales.* By O. J. R. Howarth. (Pitman, 8*s.* 6*d.*)

Here is a book about the fundamentals of our English scenery which can be highly commended. It has been published under the auspices of the Council for the Preservation of Rural England. The author has analysed our scenery to show the debt which we owe to soil, climate and contour. He gives particular evidence that the castle and manor house, and the village and church, are all part of the English countryside, and that the heritage which we enjoy is a good one with much to make us proud of it. The historical aspects of the subject are confined to one chapter. Twelve subsequent chapters deal with so many well defined areas into which England and Wales can be divided by reason of the nature and cause of its scenery. The geographical orderliness which is found along a line between the North Foreland and the Needles, provides us with a chapter on the Weald and its environment; here, inland towns preserve more or less the appearance of antiquity and none has been submerged by modern industry. The chalk belt, which stretches across England, from Kent to Dorset and from Dorset to Yorkshire, has another and equally interesting story. Then there is East Anglia, where the coast is made of soft stuff and with coast erosion at many points there are records of lost villages, of which Dunwich in Suffolk is a famous example; this easternmost slope, from the chalk belt to low shores, which merge into a shallow sea, is "a tranquil land full of minutiæ of beauty." Limestone, equally as important as chalk, also has its effect in moulding the landscape; this belt extends from the Isle of Purbeck to the Humber and reappears in the North Yorkshire moors. In the south-west corner of England the high expanse of granite moors "convey a certain sense of desolation not merely because they are bare and stand exposed to westerly storms." From what the author has to say in discussing each of these scenic divisions it is evident that the common instinct of affection for our land must soon become widespread, whereas once upon a time it was individual and relatively rare. The illustrations have been aptly chosen, but photography and reproduction could have been better.

## Straightforward Biology

*Life in the Animal World.* By F. H. Shoosmith, Ph.D., B.Sc. (Harrap. 5*s.*)

According to the statement on the jacket, this book is intended to provide "a popular and yet systematic and accurate introduction to the study of animal life in all its phases." It is well written in a straightforward, unpretentions fashion. The matter is well arranged and judiciously selected. Certainly, it is hard to think of anything of importance that is not given its proper place. The illustrations are numerous and good (with one exception) and really illustrate; that is to say, none have been put in simply because they were pretty or the author had them handy. There is a glossary of technical terms and these are also well explained in the text. The reviewer has detected one unimportant misstatement of fact, one rather ambiguous passage and no misprints. No doubt careful and systematic study would reveal more faults, but they are probably few and trivial. Lastly, the book is very cheap though well printed and well got up generally.

An improvement that might perhaps be made in future editions would be to give suggestions for further reading, particularly, where it is possible, to the works of the first-hand observers themselves and not merely to compilations. The school child who reads a book such as this can get help and advice from his teachers. The adult who picks it up and finds his interest stimulated in some particular direction may have to let that interest die away again if he does not know where to look for more information. Biology is, perhaps, the one scientific study in which the amateur, armed with the simplest equipment, or none at all, except his eyes, ears, hands and brain, can make first hand acquaintance with interesting and important facts and can hope to encounter entirely new facts. He may even, sordid though it may seem to mention it, make money out of his information. But, of course, he cannot do this without guidance at the beginning; he must be told what facts have been discovered and how they have been discovered.

A. D. Ritchie.

## Termite Fancies

*The Soul of the White Ant.* By Eugene N. Marais. Translated by Winifred de Kok. (Methuen. 7*s.* 6*d.*)

"When one wishes to write of all these wonders, one is bewildered by the *embarras de richesses*. it is hard to know where to begin." This is what the author says on the second page of his book, and it is what comes to the mind of a reviewer who would wish to treat the book as a contribution to popular science, claiming to represent a summary of over ten years' original studies in the behaviour of termites. The author has solved his problem by starting where he might have ended—namely by propounding a startling theory that one "must consider a termitary as a single animal whose organs have not yet been fused together." The rest of the book is devoted mainly to supporting this idea by spectacular but pathetically naive parallels. The walls of a termitary are to the author exactly like the skin of an animal, since both are seen in section to consist of cells, "the only difference" being that the cells of a termitary wall can be seen with a naked eye. Crowds of workers and soldiers termites running incessantly along the inner passages are just like streams of blood, the soldiers, which happen to be reddish in colour, corresponding to red corpuscles, and the workers, whose duty it is to repair the damage done to "the skin," obviously representing the leucocytes. Other workers which masticate vegetable matter serving as medium for cultivating fungus gardens are regarded as a part of the digestive system, while the gardens themselves are the stomach and the liver of the composite animal. The queen, without which the life of the termitary cannot go on, obviously represents the brain, and "even the substance of the queen's body is reminiscent of the brain of mammals." Peripheral nervous system is unfortunately lacking, but this cannot confuse the author because, "when one knows the answer to a problem, it can never appear impossible to solve." Thus, it appears that the nerves are not really necessary for transmitting the impulses to organs, for according to the author the functions of vital organs (not specified) occur independently of the nervous system, and are directed by "impulses-at-a-distance." This being the case, the queen regulates the life of the termitary by sending such impulses. Reproductive system is, of course, represented by the winged males and females. On the whole, there is no doubt in the author's mind that "the termitary is a separate composite animal at a certain stage of development, and lack of automobility alone differentiates it from other such animals." Even this difference appears to be a temporary one, since "if natural

selection continued to operate, the final result will be a termitary which moves slowly over the veld."

Such an amazing conception of a colony of social insects could be developed only by an enthusiastic dreamer, with some smattering of anatomy and physiology, but without any idea of scientific method. It is not surprising that the author is carried away by his pet idea to announcing boldly that "there are hundreds of facts, biological and physiological, in nature, which prove that all highly developed animals have been formed from separate organisms." The translator in the preface states that the author's conception of a termitary as a composite animal has a priority over a similar theory of another and more famous writer, Maurice Maeterlinck. They were, however, both forestalled by the Greek philosopher Empedocles who taught already in the 5th century B.C. that heads, arms, necks and other parts of animals appeared in the world independently, and only gradually found each other and formed complete animals.

It is only fair to say that, apart from such grotesque theories, the book contains a number of most fascinating facts of termite behaviour, some of them never observed before. For a naturalist, however, it is most irritating to read their descriptions, since the author scarcely ever describes facts as he saw them, but presents them in such a way that it is impossible to see where the observations end and wild speculations begin.

One well believes the translator of the book (originally published in Afrikaans) that the author was well known in South Africa as a writer of short stories and verse. The book reads as an amazing and fantastic story. This should make it very popular with those readers whose interest in biology is restricted to its "mysteries" and "wonders," particularly when they are presented in such a brilliant way. In any case, the book belongs rather to fiction than to popular scientific literature.

B. P. Uvarov.

## Modern Aeroplanes

*Aeroplanes and Aero Engines.* By Captain P. H. Sumner, late R.A.F. Second Edition. (Technical Press. 15*s*.)

The author explains in his Preface that he has completely rewritten the book to bring it into line with current practice, because the rapid advance that has been made in aeroplane design and achievement has rendered the earlier work obsolete. He maintains that the book does not purport to be a technical treatise but the treatment of the subject is one for which a need is felt—in fact, it is a second edition.

After an introduction which is mainly historical he describes in some detail the principles of flight or, as he names them: the principles of sustentation and transition. He continues with a short chapter on airscrews, a long chapter on the working of the internal combustion engine, and another chapter on types of aero engines. Materials and the general construction of the aeroplane are next described and accompanied by a very elementary account of the rigging and truing-up of an aircraft. His remaining chapters contain general performance data of many modern aeroplanes and a description of some common aeronautical instruments. The index is so brief as to have little value for the reader.

The book as a whole is attractive at first sight. The illustrations are well chosen, attractive and numerous. The photographs are clear and the textual illustrations are largely self-explanatory. The printing is clear, well arranged, and also attractive. The scheme of the book covers a wide field and embraces much detail that an ordinary reader interested in the subject will be glad to learn. There is, however, a lack of continuity throughout and the reader is left with an impression that he has learnt many facts without realising how they are blended together in one whole. The reader must also be careful how he uses the facts given throughout this volume without verification from some standard work of reference. Many pages give lucid and correct descriptions of detail and explanations of technique. Intermediate pages will be found with many errors in them. Whereas the illustrations are almost without blemish the text throughout is faulty in descripcion, in explanation, in lack of knowledge of present-day aerodynamic and engine theory and even in numerical data. From a purely technical standpoint the book makes interesting reading, but it is full of pitfalls.

J. L. Nayler.

## The Roads of Thought

*Mind and Memory Training.* By Ernest E. Wood. (Pitman. 5*s*.)

In this attractive book Mr. Wood differs from many educationalists in showing us not how to acquire knowledge but how to develop the power of our minds. "If I may follow up the analogy of an engine," he says in his opening chapter, "we require three things for the good working of our mental machinery—cleaning, lubrication, and control."

He goes on to explain that there are four roads of thought, the law of *class*, the law of *parts*, the law of *quality* and the law of *proximity*. Take the case of a cow. You think of her as one of many animals (class), secondly of her eyes, nose, hoofs and so on (parts), thirdly of her size, colour, and habits (quality), and lastly of the meadow and the farm-yard around her (proximity). The roads of thought are the key to the author's deductions from his study of the management of the mind, the cultivation of the imagination and the processes of reasoning.

The book is full of original and practical suggestions of value to the educationalist, the student, and the more casual reader. We are told, for example, that if we have half an hour to study a subject we should spend the first ten minutes in thinking out exactly what we already know about it, in order that our reading may become more real and more linked with our previous experiences.

The author also gives valuable advice upon memorising and upon methods of concentration. The latter, however, is superfluous as far as his own book is concerned as the interest is too sustained for the minds of his readers to wander.

J. H. Blaksley.

## American Gorilla-Hunters

*In Quest of Gorillas.* By William K. Gregory and Henry C. Raven. (Darwin Press, New Bedford. $3.50.)

It is about as easy to get permission to shoot a man as a gorilla, but the joint influence of Columbia University and the American Museum of Natural History effected the miracle. On May 29th, 1929, an expedition of four American zoologists left for the Belgian Congo and French Cameroon, with the object of shooting specimens of the eastern and western races; and this book is a lively, entertaining and interesting account of their adventures.

Perhaps the most startling statement in the book is that,

as the eating of men is out of date, the natives of the French Cameroon kill ten times as many gorillas as the white man. To the logical evolutionist there is a hint of cannibalism in the idea of eating gorilla steak.

The restrictions upon the expedition's work are interesting. While most collectors are glad to shoot a gorilla in any part of the body, skin it and take the skull and hide to Europe, this party was decided that, with two specimens permitted to be killed in East Africa, there was no room for mistake. They must be shot through the head ; if they were shot through the body, many blood-vessels would be severed and the preservation of the huge body be made difficult, as the preservative fluid injected would not reach every corner. It was necessary, too, to shoot it in such a district that it would be possible to bring back the carcase, weighing 400-500 lbs., on the heads of porters. Then the huge creature must be embalmed forthwith, for the African sun brooks no delay. The body of the first one weighed 460 lbs., and it is interesting to note that it was as clean as though freshly combed. It was wrapped in a tarpaulin and lashed to a litter of saplings, the whole thing weighing a good 600 lbs., which was then carried by porters back to the camp. The second gorilla was less fortunate, as the bullet cut a great blood-vessel, on which they were dependent for the circulation of the preserving fluid. So they were obliged to empty the enormous mass of the digestive tract.

The author was struck by the extraordinary variability of the negro, for whom he shows a sympathetic regard, although he caught a glimpse of the lurking ferocity of the ordinarily genial and patient natives. He reminds us that the great dangers of Africa are not the lion, elephant, and buffalo, but the amœba, mosquito, and tsetse fly. Also of what we do not generally realise, the rivalry between man and gorilla, which find their food easier to get in men's plantations than in the forest, and it is only since the arrival of the white man that the ape has lost the upper hand.

Mr. Raven, the leader, an experienced tropical campaigner, in his hunt for the gorilla faced conditions of life that would have daunted even the most enthusiastic. Living in the bush like a native, eking out his food as best he could, he eventually collapsed and was carried to civilisation. The diagnosis showed that he had contracted sleeping sickness, two kinds of malaria, hookworm, ascariasis, and a number of intestinal parasites. But that price is cheerfully paid when men achieve the objects for which they went out.

The book gives a good picture of life in many parts of equatorial Africa, and the observations are wide and sound. There is a certain vagueness in the spelling of familiar African expressions, which is unimportant, for the essentials of the book are good, the photographs and sketches numerous and on the whole good and sometimes even striking.

MALCOLM BURR.

*The Balkans by Bicycle.* By W. PAPEL HAMSHER. (Witherby. 8*s.* 6*d.*)

The impressions of an observant young man when he discovers a new world are refreshing and often entertaining, and for that reason this cheerful account of a tour upon a bicycle across the Balkans to Istanbul is worth reading. The author was handicapped by dependence upon interpreters and does not seem to have read much of the teeming literature dealing with the countries he was visiting, with the result that he overlooked a number of interesting points. In arriving in Montenegro, for instance, he alludes to the hamlet of Njegush, evidently without being aware that it gave birth and name to a remarkable dynasty. He gives two chapters to Mount Athos, but is shaky on its history and has not read so recent and important a book as Professor Dawkins's *The Monks of Mount Athos*. But if he has not added to our knowledge of the lands he visited, he has enjoyed an enviable trip, and described his impressions brightly and with humour.

*Patents for Inventions : a Concise Guide for Inventors and Patentees.* By REGINALD HADDAN. (Pitman, 3*s.* 6*d.*)

This book has been written for the purpose of guiding inventors generally through the intricacies of patent law and procedure. The text amounts to less than one hundred pages, but therein the author deals with his subject from every aspect which can possibly provide a question in the mind of anyone previously unacquainted with patents. The usefulness of the book, however, is not restricted to this class of reader ; even those who have many patents already granted in their name may read profitably. The need for such a book is especially in evidence by reason of the fact that the British law and practice relating to " patents for inventions " has been the growth of over three centuries, and although there was a recasting of the patent system in 1883, subsequent amendments have again produced new difficulties. After telling us about the nature and validity of patents, how they may be enforced and of their commercial value, the author then deals with the object of provisional protection, methods of obtaining protection, titles and specifications, the objects of making a search, and of how to maintain the monopoly which is granted by patent. Subsequent chapters, all of which are remarkably concise, cover such matters as amendments, stamp duties, agency charges, the application for patents in foreign countries and in the British dominions and colonies, and of how to sell or license a patent. There is also a chapter on trade marks and designs, and a very acceptable page of " advice in brief."

## Books Received

*Art and Understanding.* By MARGARET H. PULLEY. (Batsford, 15*s.*)
*The Face of Ireland.* By MICHAEL FLOYD. (Batsford, 7*s.* 6*d.*)
*Composition for Photographers.* By CHARLES SIMPSON. (Witherby, 10*s.* 6*d.*)
*How to Patent and Commercialize your Inventions.* By D. B. MILLER. (Pitman, 2*s.* 6*d.*)
*Ways of Birds.* By THORA STOWELL. (Country Life, 5*s.*)
*The Dragonflies of the British Isles.* By CYNTHIA LONGFIELD. (Warne, 7*s.* 6*d.*)
*The Acanthodriline Earthworms of South Africa.* By G. E. PICKFORD. (Heffer, 25*s.*)
*Famous American Men of Science.* By J. G. CROWTHER. (Secker & Warburg, 15*s.*)
*Eighteenth-Century London Life.* By ROSAMOND BAYNE-POWELL. (Murray, 15*s.*)
*Frontiers of Science.* By CARL T. CHASE. (English Universities Press, 12*s.* 6*d.*)
*The Art of Carburation.* By R. W. A. BREWER. (Technical Press, 21*s.*)
*Field Tests for Minerals.* By E. H. DAVISON. (Chapman & Hall, 7*s.* 6*d.*).
*Butterfly Migrations in the Tropics.* Prepared by C. B. WILLIAMS. (British Museum—Natural History, 9*d.*)
*Graded and Everyday Examples in Physics.* By R. V. JOHNS, W. F. WARE, and A. I. REES. (Macmillan, 6*s.*)
*The Rationalization and Conservation of the Timber Resources of the World.* By A. H. UNWIN. (Technical Press, 2*s.* 6*d.*)
*Quest and Conquest.* By MALCOLM BURR. (Oxford University Press, 1*s.* 6*d.*)

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